For engineers who design and manage the power and plant services

Power

JULY 1959

ONE DOLLAR

A McGRAW-HILL PUBLICATION

a *TD* report

safety monitoring

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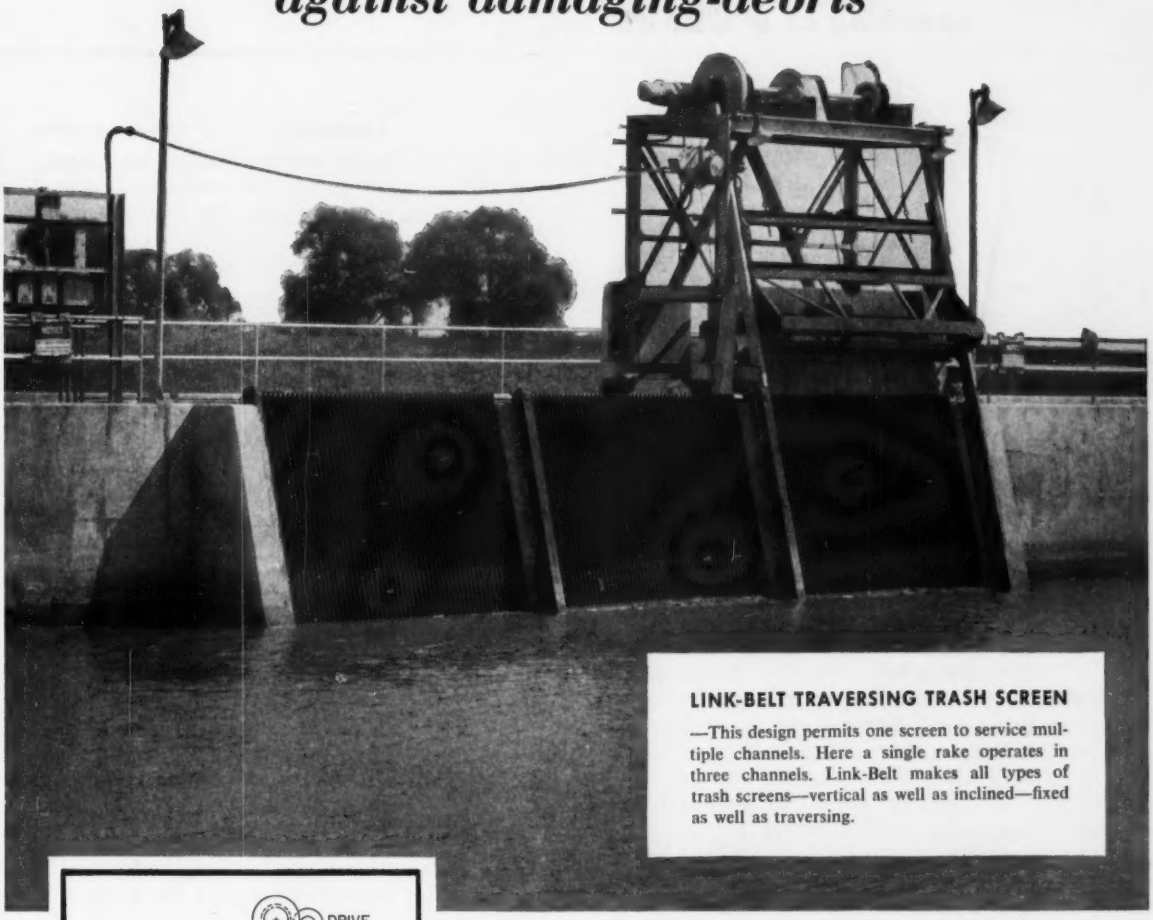
175 carloads of pipe. Not much . . . if you are thinking in terms of ordinary cast iron pipe. Quite a bit, however, when it's chrome-iron alloy Ashcolite, cast by the sand-spun process. It represents a great many power plants when you consider its limited use—that of conveying ash from the hopper to temporary storage or fill area for final disposal.

We pioneered this industry, back in 1919. Since then we've introduced the major developments, including the use of centrifugally cast wear-resistant pipe. Our years of experience, our careful consideration of job-required details, won us our position of leadership in every corner of the globe. These same attributes can be put to work for you —immediately. Write, wire or phone us . . . THE ALLEN-SHERMAN-HOFF COMPANY, 259 East Lancaster Avenue, Wynnewood, Pa. Cable: Ash-Wynnewood.

ALLEN-SHERMAN-HOFF

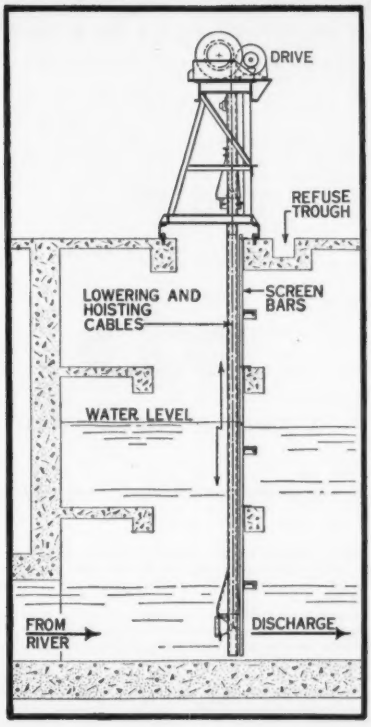
For more facts circle 201 on Reader Service card, p 99

ESSENTIAL SAFEGUARD
against damaging-debris



LINK-BELT TRAVERSING TRASH SCREEN

—This design permits one screen to service multiple channels. Here a single rake operates in three channels. Link-Belt makes all types of trash screens—vertical as well as inclined—fixed as well as traversing.



LINK-BELT trash screens provide economical, effective protection for pumps, turbines and screens.

Put a protective screen between vital equipment and destructive debris such as logs and ice. Link-Belt trash screens also reduce load on traveling water screens during heavy seasonal accumulations of leaves, Spanish moss, water hyacinths and algae.

These screens feature simple design, rugged construction. They require little attention—operation is necessary only when trash has accumulated. This is accomplished by merely pressing a button to actuate the motor-propelled rake. Refuse is then removed manually from the rake to a refuse trough. Intermittent operation keeps power costs down to a minimum.

And Link-Belt will work with your engineers and consultants in supplying whatever your plant requires in screening, coal handling and mechanical power transmission equipment. Get complete facts from your nearest Link-Belt office. Or write for Book 2587.

LINK-BELT

18,184

POWER PLANT EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

For more facts circle 204 on Reader Service card, p 99

speaking of **Power**

Honors came POWER's way again last month: our *Plant Design Issue* of October '58 received an Award of Merit, above, in the Annual Editorial Competition sponsored by the magazine *Industrial Marketing*. From 555 entries our *PDI* was judged as an outstanding single issue for the year.

With industry gearing up for major modernization and expansion, POWER editors are planning right now for an even more useful October '59 *Plant Design Issue*. It will carry about 125 editorial pages, organized into a 3-part package.

Current design thinking on specific power services, backed up by references to specific plants, will be rounded up in Part 1. And there are some new wrinkles in Part 2, the plant-design survey: industrial air conditioning tabulation will be a newcomer. Finally, as Part 3, we'll review and preview power-service literature and products covering a 12-month span. In all, it will be an issue every plant designer will find of practical value . . . one he will keep handy for future reference.

Lon Lowley

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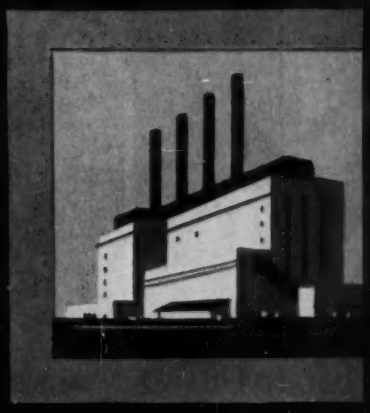
The Continuing Search For Economical Energy



Do you have a coal mine in your back yard you can't use?

In areas like Florida and the Southwest, where the use of coal has been traditionally prohibitive, utilities are now considering it as an economical, easily available fuel. Why? How is it possible? The answer is B&W research in coal and coal-burning equipment.

At B&W's Research Center, testing of over 33,000 coal samples has provided some important cost-cutting answers—answers that will help you hold the line on operating costs. Important answers that permit building equipment around the fuel you can most inexpensively burn.

What's more, B&W recommendations are completely objective. B&W designs and manufactures all types of fuel burning equipment—for every fuel burning application.

For example, the most economical and satisfactory way to burn lower-grade, high-ash, low-fusion coal, is in the B&W Cyclone Furnace. Less space, fewer burners, more complete fuel consumption, and elimination of fly ash problems are just a few of its many advantages.

We will be glad to discuss your fuel burning problems with you, and to make recommendations based on your special requirements. Write to The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

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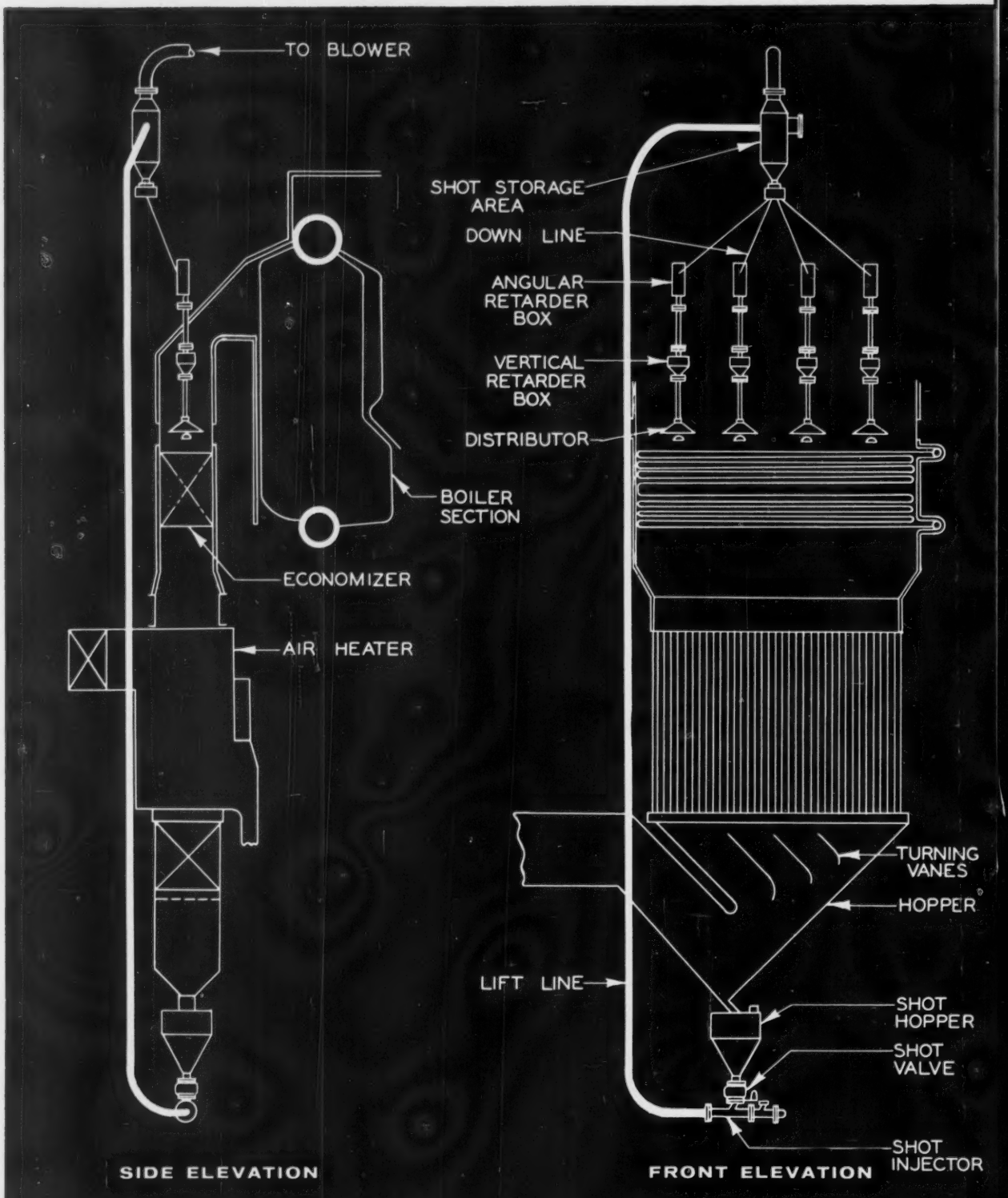
BOILER DIVISION

G-908-CS



TYPICAL SHOT CLEANING SYSTEM

DIAMOND
SHOT CLEANING

Its Advantages

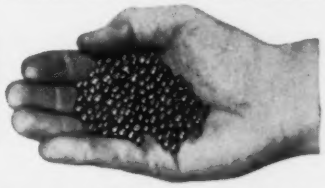
This system offers much improved cleaning of certain areas of boilers such as tubular air heaters, horizontal superheaters, economizers, and reheaters. It will often accomplish effective cleaning where this has not been possible previously. Areas which tend to foul rapidly may be kept completely clean by increasing the length of the automatic shot cycle (it may be continuous if necessary) without disturbing boiler operation. No platforms or galleries are needed as with conventional cleaning equipment so aisle space often may be reduced.

Uniformly low draft loss and constant flue gas temperature are easily maintained because deposits are removed before they impair the thermal efficiency of the plant.

How It Works

Falling shot, spread uniformly by distributors scours the fouled area. Deposits are removed in small particles, most of which are carried away by the gas stream. Heavier particles fall into the shot hopper and recirculate with the shot until broken fine enough to pass out with the gases. Cleaning is thorough even with difficult fouling such as is found in black liquor fired boilers. The same quantity of shot will clean the entire vertical section with no limitations in height.

Operation is automatic. Shot is lifted pneumatically from the hopper to a shot storage area where it falls by gravity through retarder boxes to the distributors. Length and frequency of cleaning cycle are chosen according to the fouling rate of the area and the type of deposit.



Cleaning is accomplished by thousands of steel shot that cascade over tube surfaces and ricochet from tube to tube, or through the insides of air heater tubes.

More than 30 Diamond Shot Cleaning Systems are now in successful operation in the United States . . . some of them since 1954. This is the result of Diamond's extensive research in shot cleaning over a period of years. In Europe shot cleaning has been in use over ten years and there are more than 800 installations in highly satisfactory operation. To supplement our developments, Diamond has acquired U.S. rights to the Broman-Ekstrom System used in Europe.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

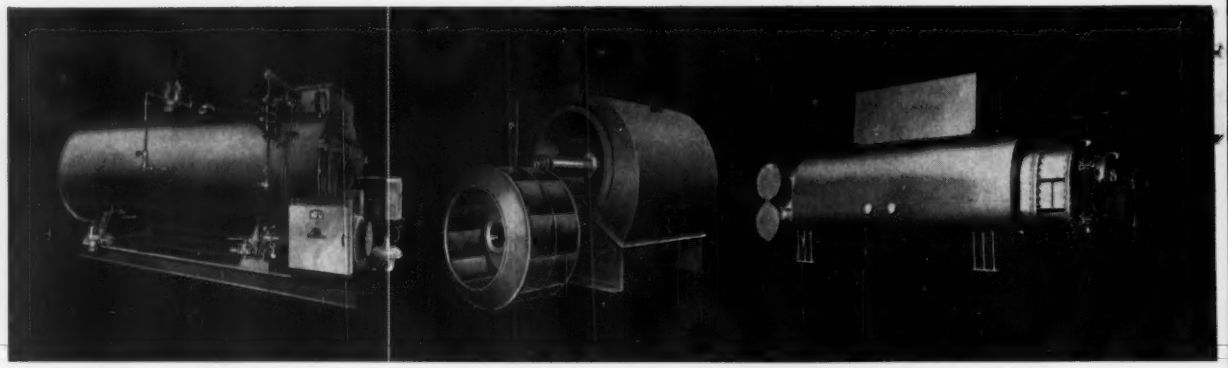
WRITE FOR BULLETIN 2145 U

It gives complete details on Diamond Shot Cleaning. For better, more economical boiler cleaning, the answer always is Diamond.

8255

For more facts circle 206 on Reader Service card, p 99

Ready for



Firebox, scotch-type, and package boilers for heat, steam, and industrial power.

Mechanical draft fans for induced and forced draft duty in power plants.

Balanced-flow surface condensers for condensing turbo-generator exhaust steam.

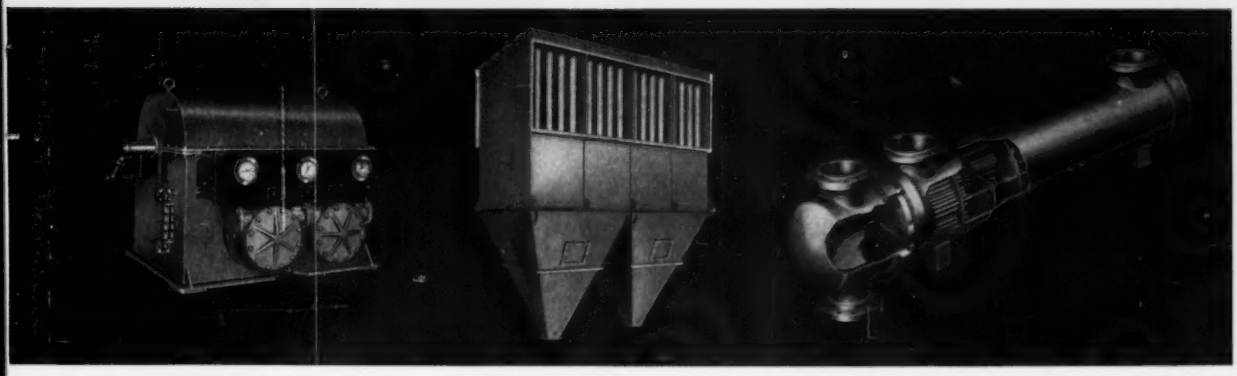
One call for all

bids on power-plant equipment?

Be sure one of them is from

AMERICAN-Standard Industrial Division

HERE'S WHY: You get *one-source responsibility* for quality and performance in equipment designed, engineered, and manufactured to work together. Combining three American-Standard* divisions—American Blower, Ross Heat Exchanger, Kewanee Boiler—the new Industrial Division encompasses the six major fields of air conditioning, heating, ventilating, heat transfer, dust collection, and fluid drives. Contact our nearest office. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Limited, Toronto, Ontario.



Fluid drives for adjustable-speed control of feed-pump flow and fan volume.

Dust collectors and precipitators for recovering fly ash, eliminating dust.

Standard and engineered heat exchangers and feedwater heaters for every duty.

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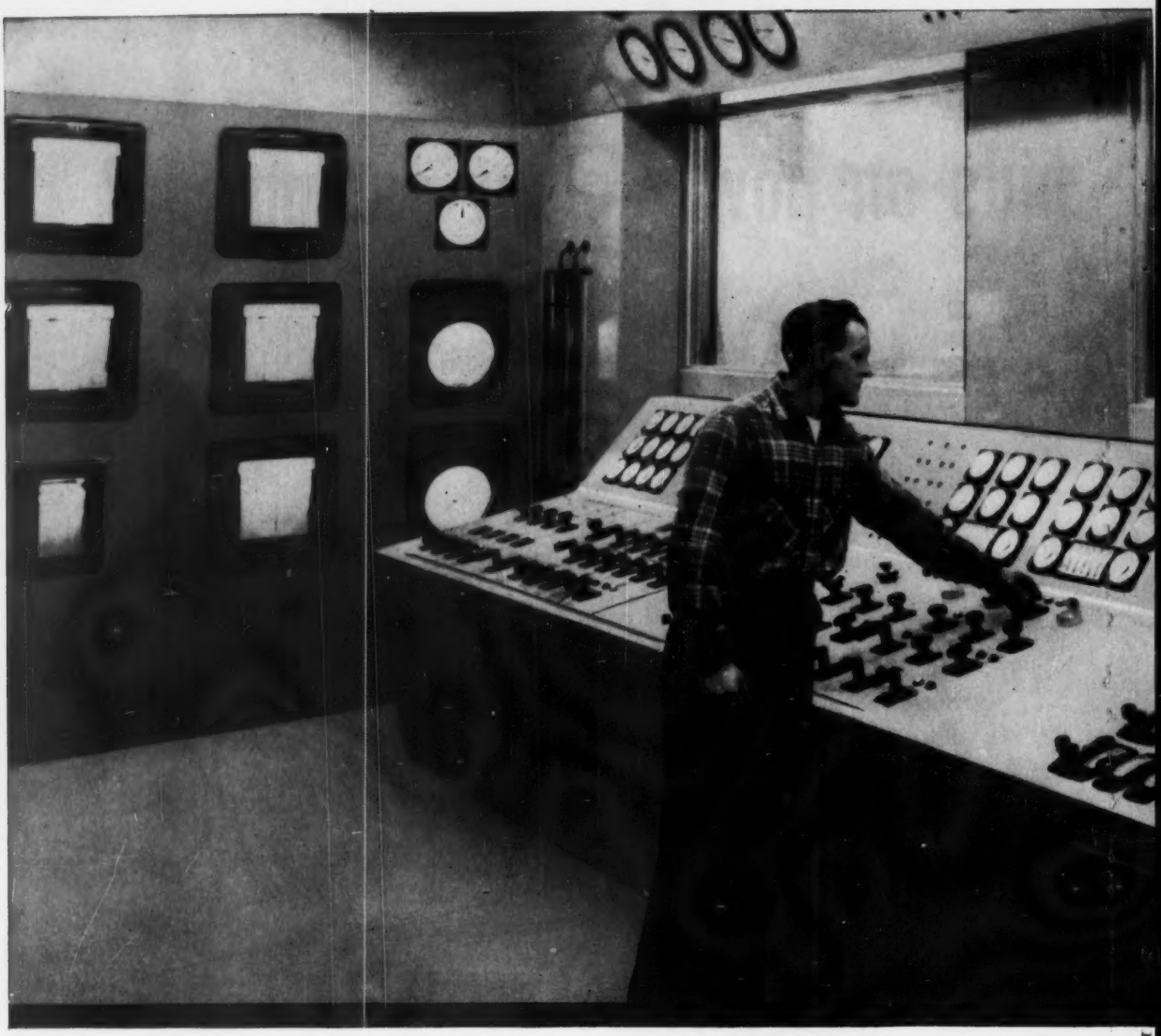


How Bailey helps you get a new

The thrill of putting a new station "on-the-line" can be marred if steam plant meters and controls don't work smoothly, efficiently. You are a lot surer of a fast, safe start and dependable operation for a long time when you specify Bailey Meters and Controls. They are keys to peak efficiency and low operating costs.

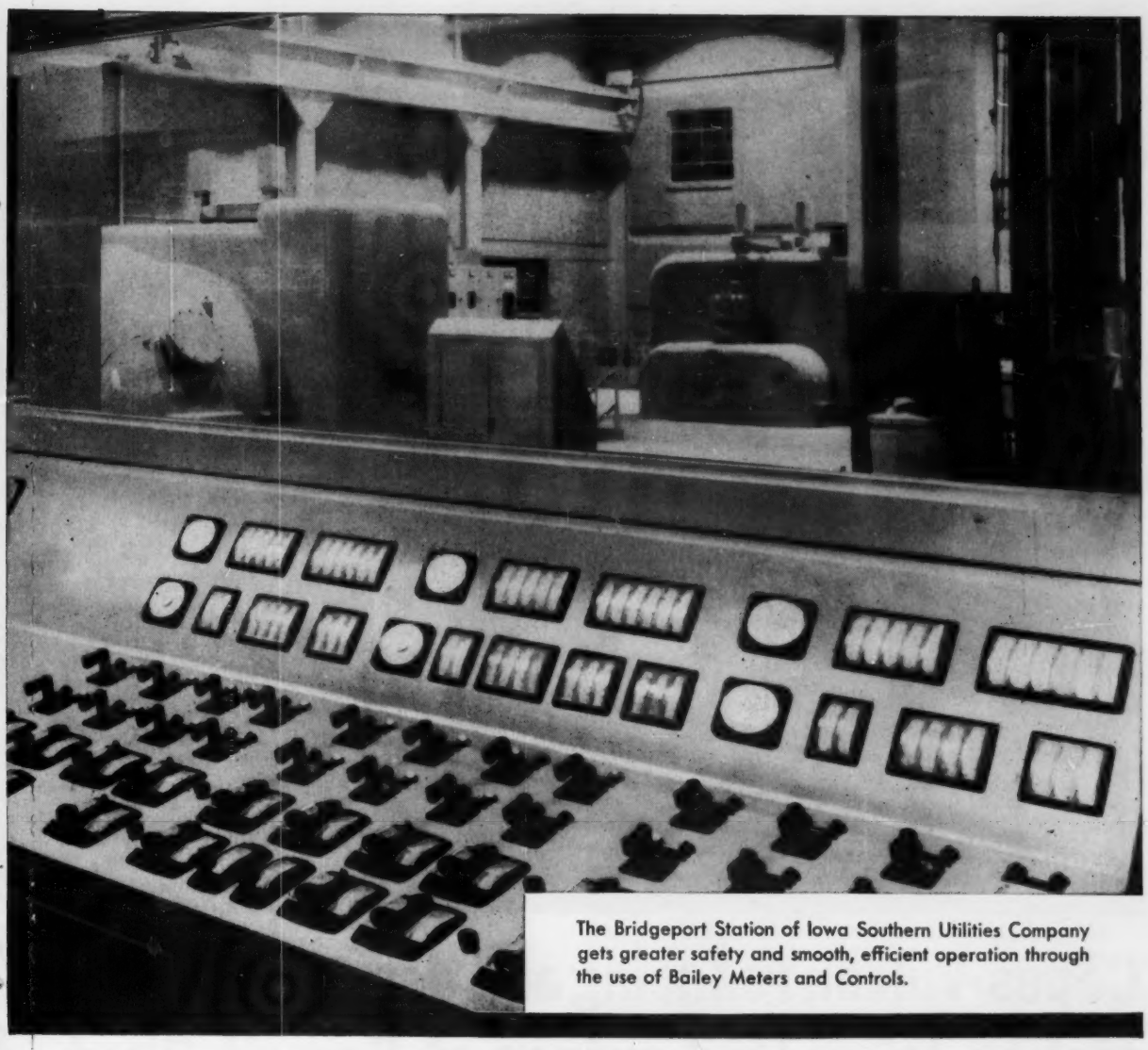
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



The Bridgeport Station of Iowa Southern Utilities Company gets greater safety and smooth, efficient operation through the use of Bailey Meters and Controls.

station off to a fast, safe start

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A131-2

BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

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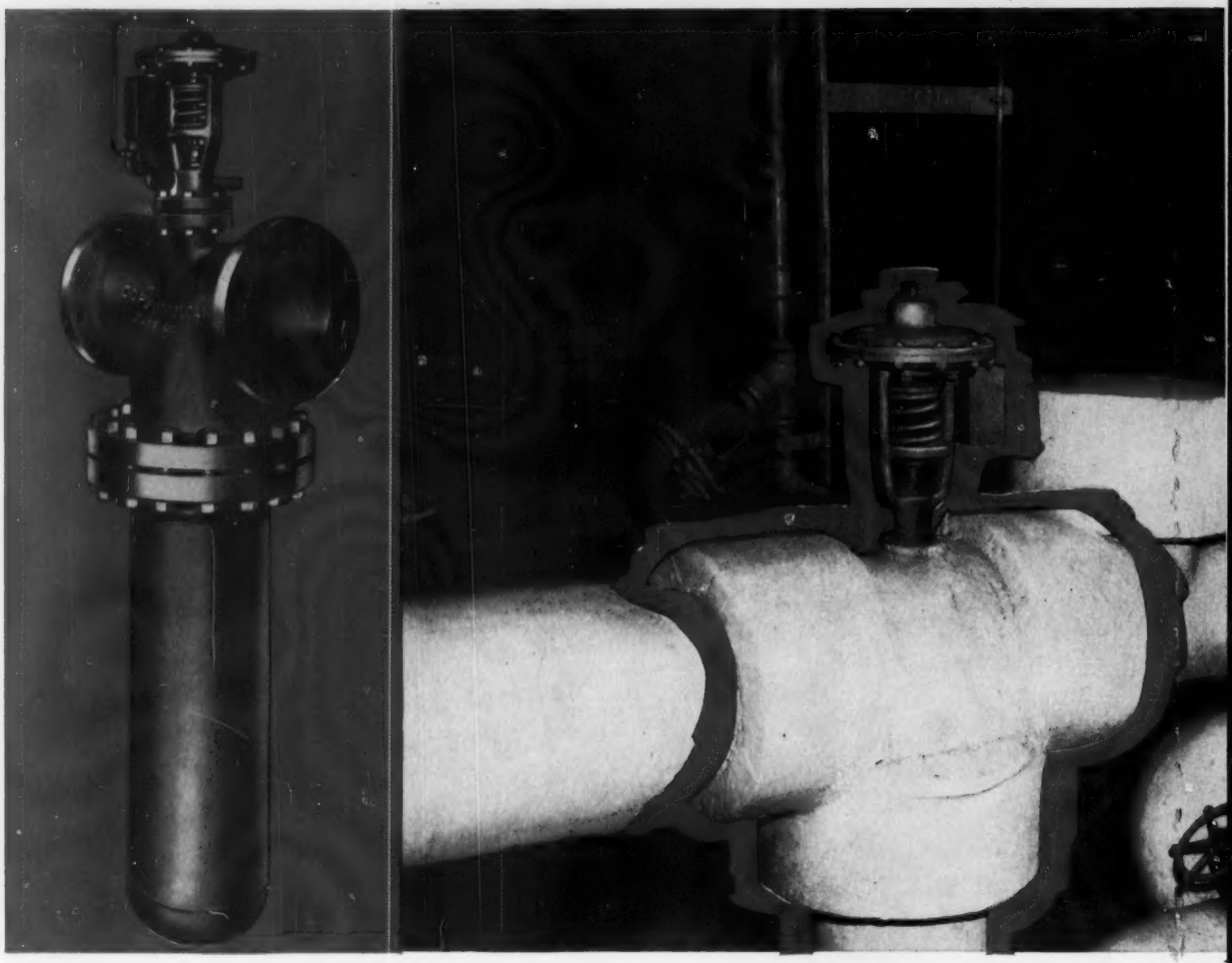


Copes-Vulcan reducing and desuperheating station takes load swings at Barrett Plant

Long Island Lighting Company uses a Copes-Vulcan desuperheating and pressure reducing station at their Edward F. Barrett Station. Steam is delivered to the reducing and desuperheating station at 2015 psig and 1005 F. Specifications require the station to condition flows of 500 to 25,000 pounds per hour down to 165 psig and 385-400 F. Maximum flow is 1000 pounds per hour in spring and fall, 3,000 pounds in winter.

During the evening hours in the winter, the generating unit comes down to half load or less, requiring the PR&D station to feed pre-heater steam coils. When the steam coils are supplied from the PR&D station the load swings from 3,000 to 17,000 pounds per hour in 30 seconds.

Made up of a Copes-Vulcan Carburetor-Type Desuperheater and a heavy service, piston-type valve, this station has provided trouble-free operation since its installation two years ago.

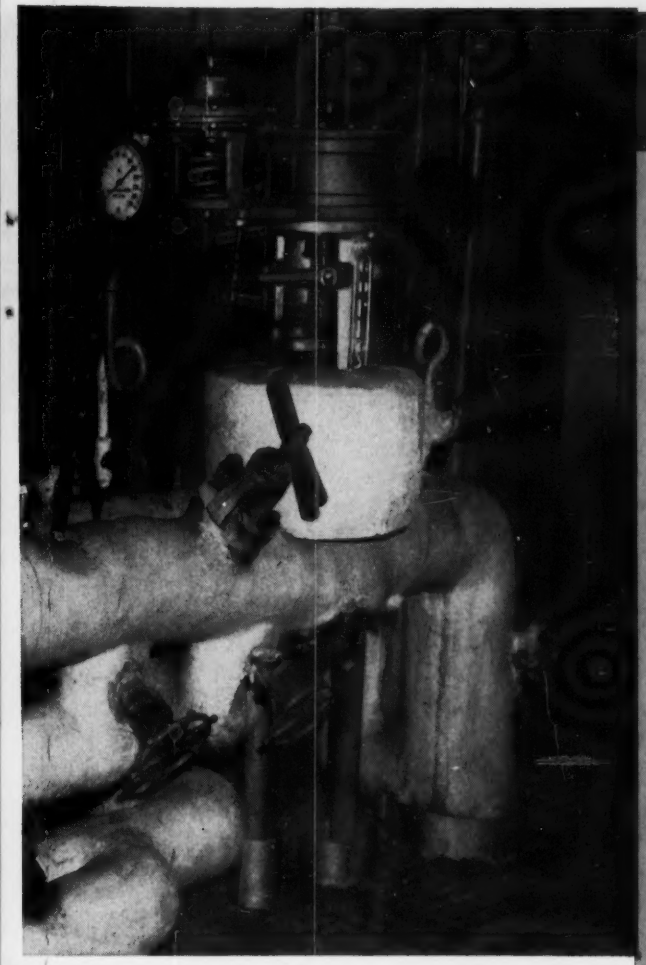
Besides the Carburetor-Type, Copes-Vulcan offers two other types of desuperheaters.

Steam-Assist Desuperheater has negligible permanent pressure loss on loads of 15% to 100% of maximum. This in-line desuperheater normally uses assisting steam only on light loads where control is most difficult. Write for Bulletin 1024-A.

Variable-Orifice Desuperheater holds reduced steam temperatures constant less than 20 feet downstream from desuperheater outlet over a 50-to-1 load range. Write for Bulletin 1037.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

C-V NEWS NOTES



Above—**3,000 TO 17,000 POUNDS PER HOUR IN 30 SECONDS** . . . That's the load swing handled by the Copes-Vulcan pressure reducing and desuperheating station during winter nights when steam coils are put into service.

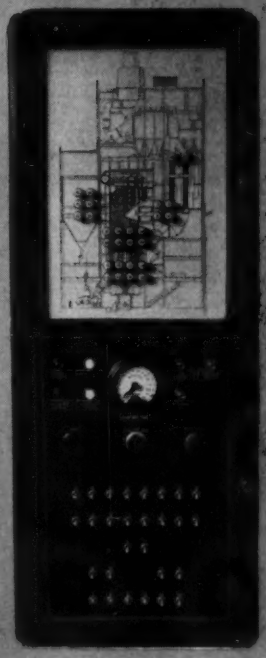
Upper left—**CARBURETOR-TYPE DESUPERHEATER USED AT BARRETT STATION.** Superheated steam is directed to pass the spray nozzle, which injects cooling water into the steam before it enters the mixing chamber. The flow of cooling-water is controlled at the spray nozzle to maintain a pressure drop across the nozzle at all flows. Cooling-water spray entering the mixing chamber is instantly evaporated, thus lowering the steam temperature to that desired. Final temperature may be held within plus-or-minus 5°F.

Available in standard 2" through 12" sizes, in 150- through 600-pound pressure standards for cast steel. Larger sizes and higher pressure standards are available on special application. Write for Bulletin 1056.

BARRETT STATION CONTROLS SOOT BLOWING on Unit 1 with a Vulcan Automatic-Sequential System. Vulcan Automatic-Sequential Control Systems can use steam, air, or a combination of both as the blowing medium.

Without leaving the panel, the operator can pre-select any number of units to be operated through automatic sequence, or individually . . . may reverse any soot blower at any point in its operating cycle . . . or switch from automatic-sequential to single-unit operation.

For details on Vulcan's complete line of automatic soot blowing stations, write for Bulletin 1029. (Panel shown gives automatic-sequential control for up to 60 soot blowers.)



PISTON-TYPE VALVES FOR PRECISION CONTROL of pressure, temperature, and liquid level. Piston actuation develops high forces to deal with static and dynamic unbalances, and with stuffing box friction. These valves meet rigid requirements for unusually high operating force and accurate positioning.

Copes-Vulcan also builds diaphragm-type CV-D Valves which may be direct- or reverse-acting. They offer excellent rangeability, and can be profitably applied to many jobs.

Both types available for pressure standards from 125 through 2500 pounds. Each valve is tailored to its job. For details, write for Bulletin 1027.

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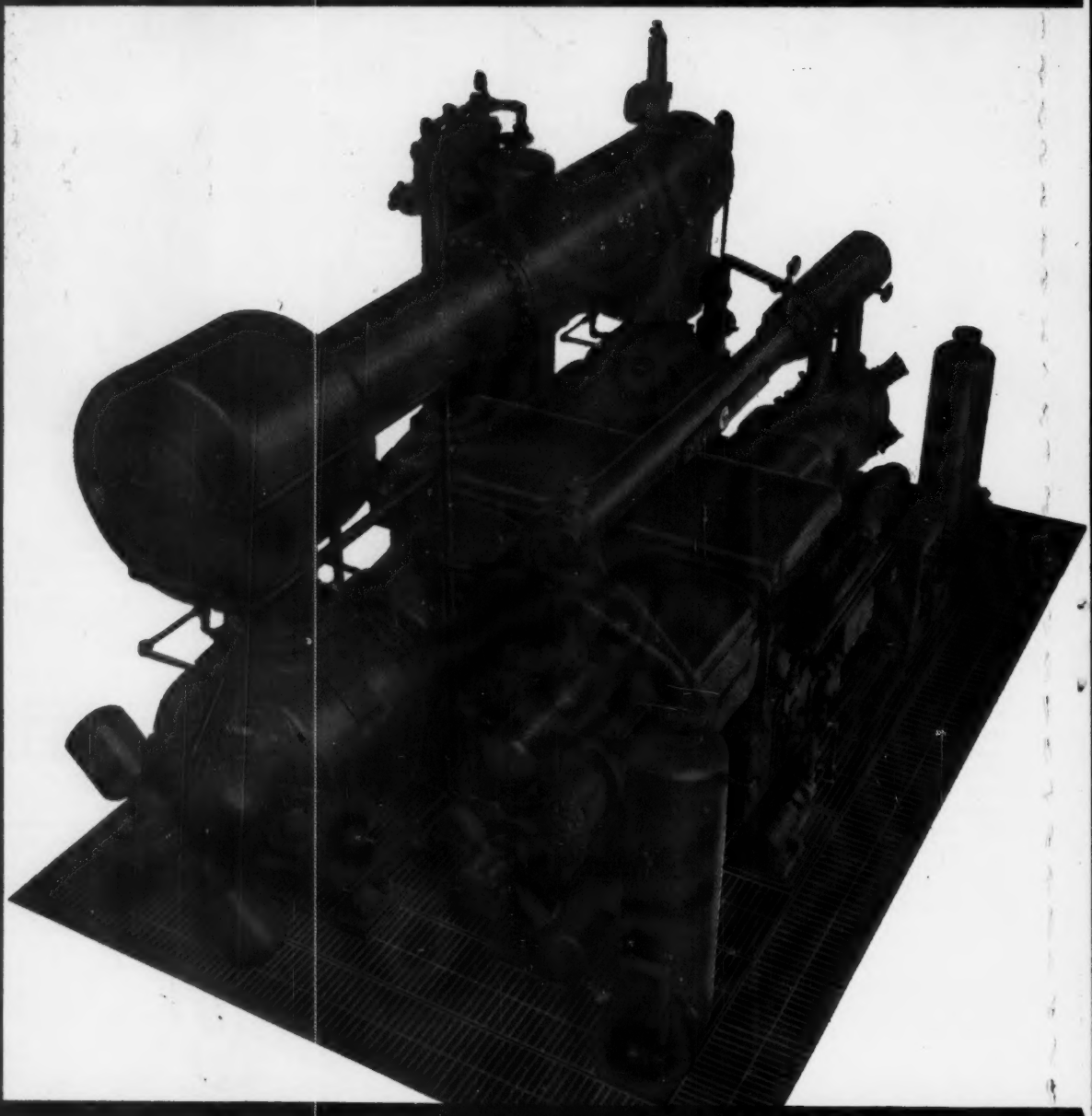
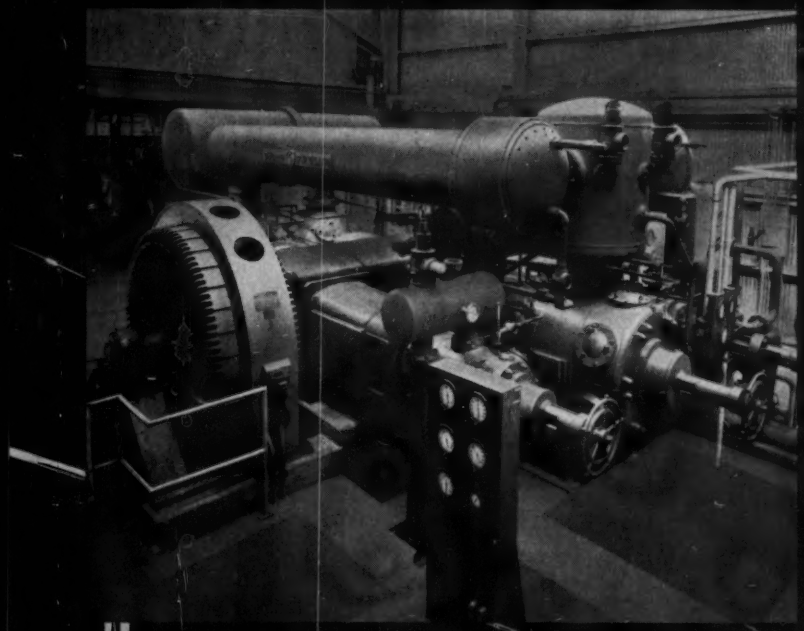
CLASS FE FOR PROCESS WORK



2000 HP four stage, Class FE-44 compressor

COMPRESSORS



The Class FE Compressor is one of several types available for process work. Readily adaptable in single and multi-stage designs for low or high pressure service, these balanced-opposed compressors require a minimum of attendance and insure maximum availability.

- ★ Suitable for direct motor drive or gear drive
- ★ In sizes to 5,000 horsepower
- ★ For pressures to 15,000 pounds or vacuum service

2500 HP five-stage, Class FE 55 compressor

Chicago Pneumatic 8 East 44th Street, New York 17, N. Y.

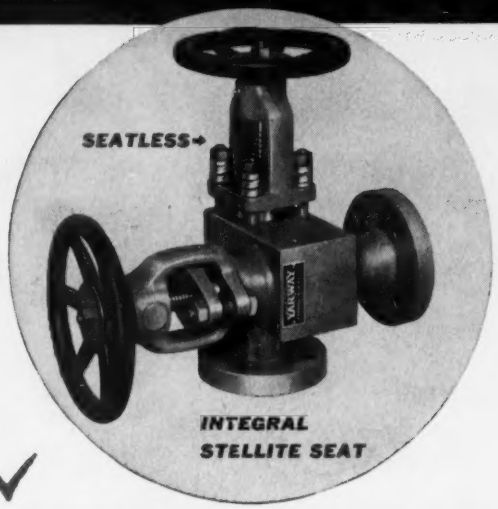
AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

IT'S BOILER

Check these 7 ways Yarway

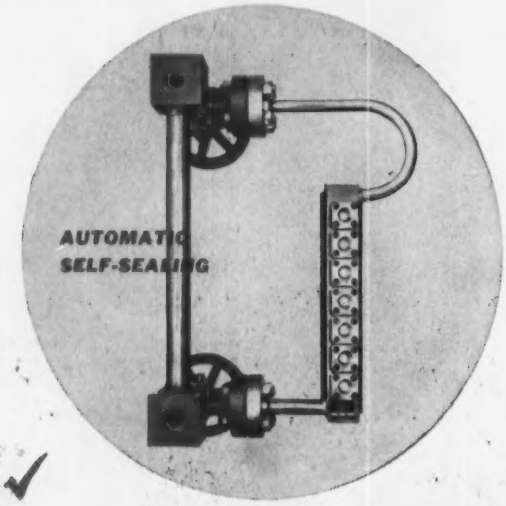
BLOW-OFF VALVES, LOW PRESSURE

This is the famous blow-off valve with no seat to score, wear, clog or leak. It's a standard in over 16,000 boiler plants. If your blow-off valves are obsolete or worn, consider new Yarways. Another point—all Yarway design and metallurgical improvements are interchangeable with parts of earlier model Yarway valves. See Bulletin B-427.



BLOW-OFF VALVES, MEDIUM & HIGH PRESSURE

A new development—the Yarway Medium Pressure Unit Tandem Valve for pressures up to 665 lbs.! A Yarway Seatless Valve and a Yarway Integral Stellite Seat Valve are combined in a forged steel body for rugged dependability. There's no other blow-off valve like it! Ask for Supplement A, Bulletin B-435. For high pressure Yarway Unit Tandem Valves to 3206 lbs., ask for Bulletin B-435.



WATER LEVEL GAGES

Yarway Color-Port Gages give you a new standard of service convenience and readability for water gages. They are automatically self-sealing, have individual port assemblies that can be replaced in minutes with the gage in the line, and show brilliant red and green readings. All these contribute to greater efficiency. Two lines—medium pressures to 1050 psi; high pressures to 3000 psi. See Bulletin WG-1815.

REMOTE WATER LEVEL INDICATORS

Yarway Remote Water Level Indicators have new "wide-vision" faces, can be pressure and temperature-compensated, may be used under Code Case #1155, can be equipped with remote lights or horn signal alarms or electronic secondary indicators. Add these features to your plant for greater safety and convenience. See Bulletin WG-1825.

CHECK-UP TIME AGAIN!

can help improve your steam plant efficiency

HIGH PRESSURE/HIGH TEMPERATURE VALVES

Scores of high pressure/high temperature valve applications call for the Yarway Welbond Valve. Only Welbond combines such features as non-pitting stainless-steel valve stem, non-distorting integral stellite seat and self-aligning disc, special inhibited packing, accessible working parts. Two lines—1500 psi and 2500 psi. See Bulletin B-453.

STEAM TRAPS

Modern Yarway Impulse Steam Traps will improve efficiency of your power plant and reduce maintenance. The Yarway Impulse Trap features only one moving part, is good for all pressures, has stainless steel construction, small size and light weight, is quick heating, and non-freezing. There is now a Yarway Impulse Trap for every steam plant application—indoors and out. See Bulletin T-1742.

EXPANSION JOINTS

"Boiler check-up time" is "steam line check-up time," too! Yarway Gun-Pakt Expansion Joints offer unequalled features in slip-type joints. Repacked under full steam pressure with no shut-downs or service interruptions. New one-piece design for body and gland. New convenient arrangement of packing guns. Durable chromium-plated seamless steel sleeves. Positive alignment. See Bulletn EJ-1917.

THESE FREE ARTICLES WILL HELP YOU IN YOUR JOB. Write for them.

"HOW TO KEEP YOUR BLOW-OFF VALVES ON THE LINE"
Reprint of recent article by Yarway Engineer, E. E. Finsel

"OVERHAUL H-P BOILER WATER GAGES RIGHT"
Reprint of magazine article by Yarway Engineer, Frank Ptacek

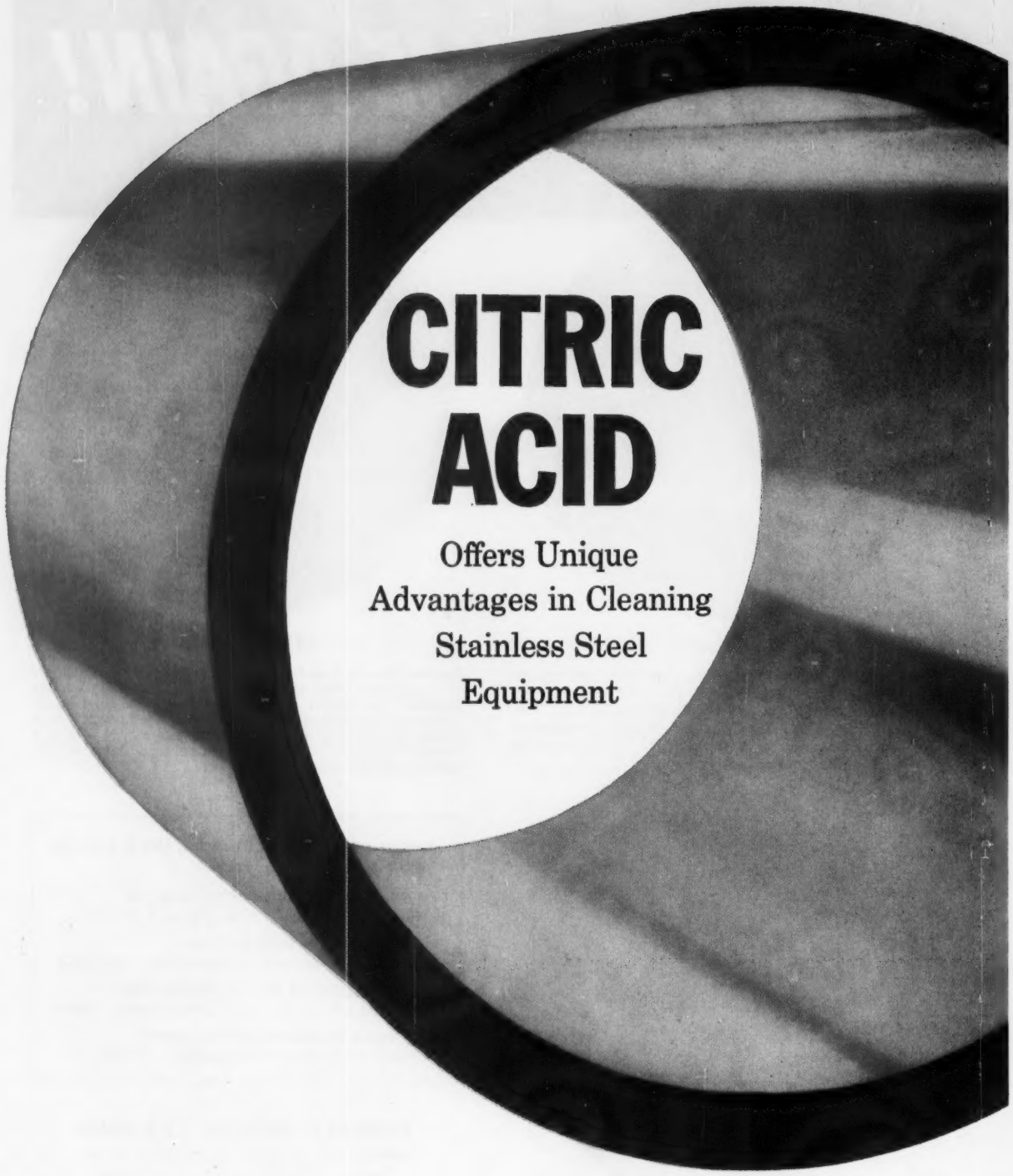
"DESIGN PROCEDURE FOR SLIP-TYPE EXPANSION JOINTS"
Reprint of new article by Yarway Engineer, Kenneth S. Roberts

"HOW SHOULD WE OVERHAUL OUR STEAM TRAPS?"
Helpful, timely article by Yarway Engineer, L. G. Chase

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
STEAM PLANT EQUIPMENT

For more facts circle 211 on Reader Service card, p 99

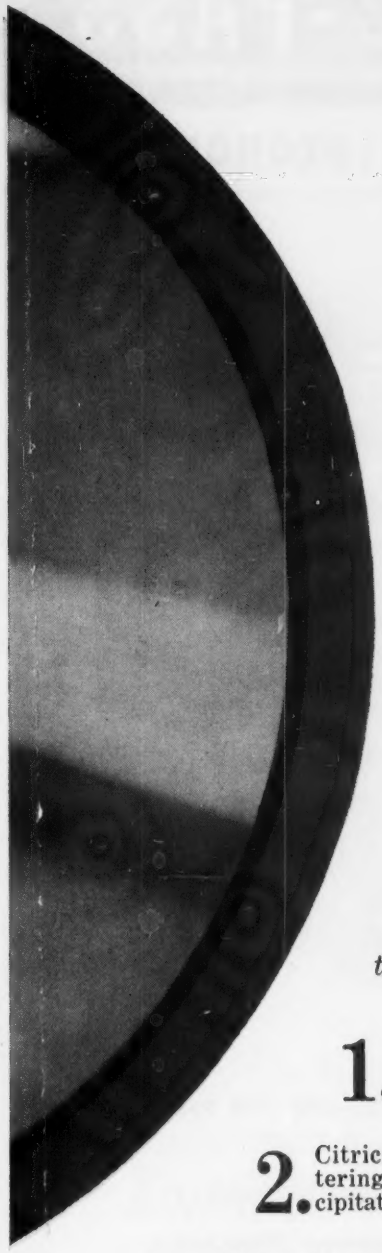


CITRIC ACID

Offers Unique
Advantages in Cleaning
Stainless Steel
Equipment

Manufacturing Chemists for Over 100 Years

CHAS. PFIZER & CO., INC. • ***Chemical Sales Division*** • 630 FLUSHING AVENUE, BROOKLYN 6, N.Y.



For chemical cleaning of stainless steel equipment such as boilers, heat exchangers, atomic reactors and chemical processing equipment, citric acid is the product of choice. Now, by using citric acid (which is chloride free), you can be sure *of safe, efficient cleaning with reduced after-rinsing.*

Citric acid has a history of proven success.

Here are the unique advantages of Pfizer Citric Acid that you can discuss with your chemical cleaning service company:

1. Citric acid is highly efficient in removing imbedded metal and oxide film from stainless steel.

2. Citric acid's excellent sequestering ability prevents reprecipitation of dissolved scale.

3. Citric acid cleaning completely eliminates the possibility of chloride stress corrosion.

4. Citric acid can be effectively inhibited without losing its cleaning or sequestering ability.

5. Citric acid is sold as a dry, 100% acid—meaning savings in storage and handling.

6. Citric acid is water soluble, easy to handle, and non-toxic.

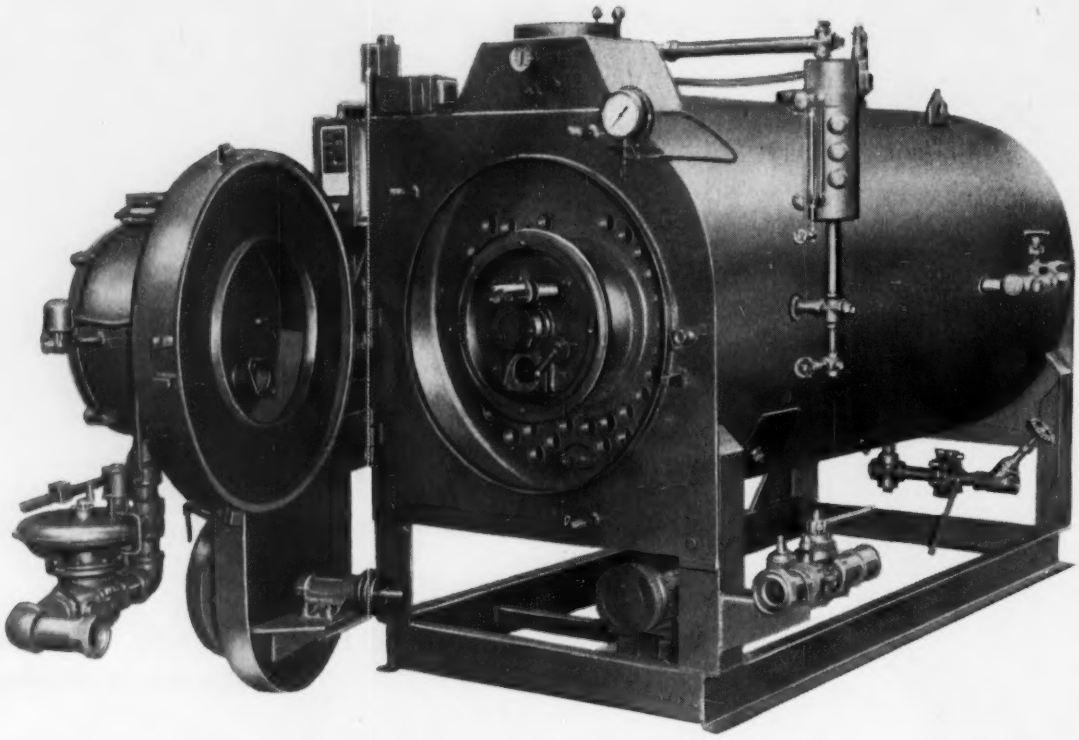
Pfizer *Science for the world's well-being*

Branch Offices: Clifton, New Jersey • Chicago, Illinois • San Francisco, California • Vernon, California • Atlanta, Georgia • Dallas, Texas • Montreal, Canada

For more facts circle 212 on Reader Service card, p 99

why *Continental* 2-PASS

low first cost . . . operating economy



Continental

2-PASS DESIGN...

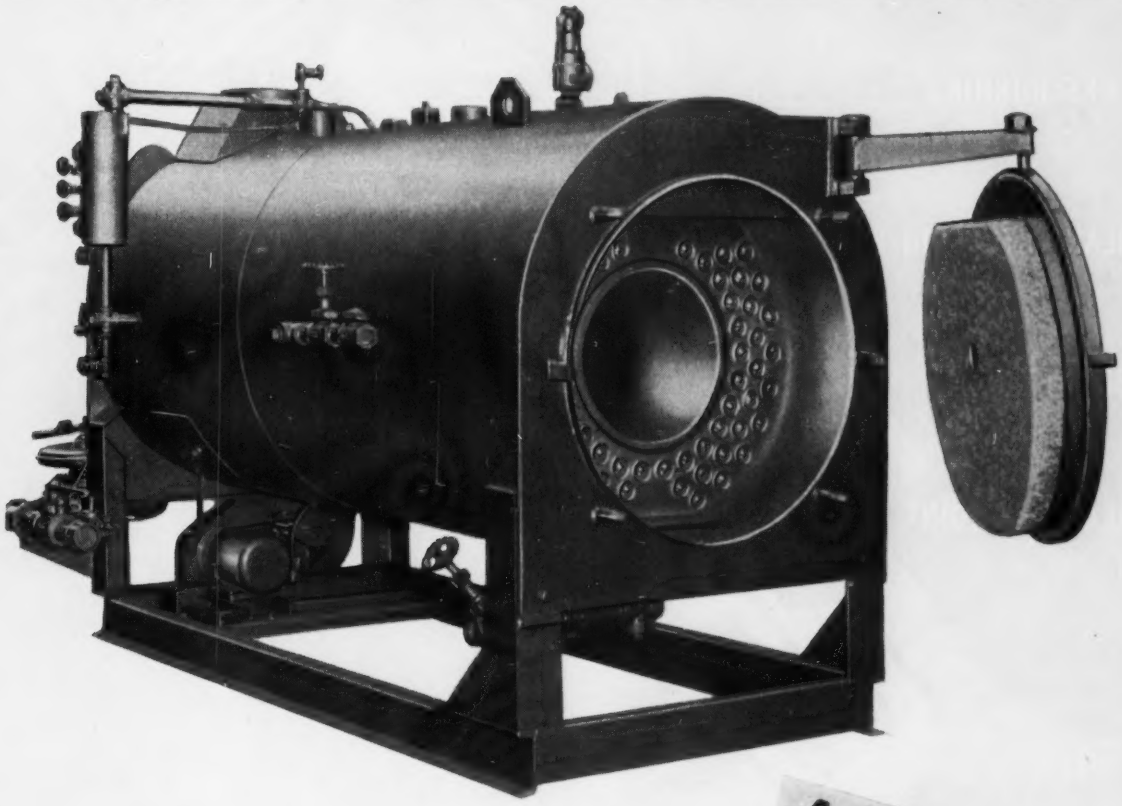
- **20 TO 600 HP STEAM BOILERS—TO 250 PSI**
- **HOT WATER AND HTW BOILERS**
- **OIL—GAS—COMBINATION OIL/GAS**

The most practical and economical approach to heat transfer in PACKAGED BOILERS today. Check these reasons why:

- ✓ **Eliminates separation baffles required in "excess" passes**
- ✓ **Balanced internal circulation for higher efficiency, longer life**
- ✓ **Uniform heating of boiler surfaces**
- ✓ **Easier accessibility with hinged front door, davited rear door**
- ✓ **Compact design saves valuable space in boiler room**
- ✓ **Simple construction eliminates need for highly skilled operating and maintenance personnel**
- ✓ **Turbulent spinning gas technique for more efficient combustion, maximum heat transfer**

Boilers are your Best Buy

. . . easier, time-saving maintenance



NEW!

THESE OTHER
Continental
FEATURES mean important savings, improved performance:

- Forced draft
- Quiet operation
- High quality steam
- Quick change dual fuel burner
- Easy installation

SEND FOR THIS DATA FILE . . .

Get the facts on how a Continental Two-Pass Automatic Boiler can solve your problems. Write today on your company letterhead for latest data.

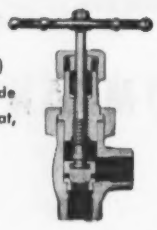
BOILER ENGINEERING & SUPPLY COMPANY, INC.
Phoenixville, Pa.

A HALF CENTURY OF BOILER BUILDING EXPERIENCE

For more facts circle 213 on Reader Service card, p 99

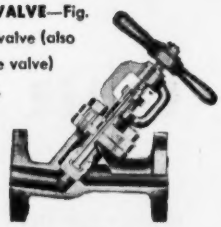
EDWARD FIG. 848 GLOBE VALVE ILLUSTRATES VALVE SELECTION PRINCIPLES

1 ANGLE VALVE—Fig. 2699, 600 lb at 900F (2000 lb WOG) with union bonnet, inside screw, replaceable seat, knobbed handwheel, and screwed ends. Sizes ¼" to 1".



2 UNIVALVE®—Fig. 2224, 1500 lb. at 1050 F (3600 lb WOG) or 2500 lb at 1050 F (6000 lb WOG) with outside screw, Impactor® handle seal-welded bonnet, integral seat and socket welding ends. Sizes to 2½".

3 BLOW-OFF VALVE—Fig. 641, straightway valve (also available as angle valve) 300 lb at 850 F, 600 lb at 850 F, 1500 lb at 850 F, with integral Stellite seat, flanged ends, bolted bonnet. Sizes to 2½".



What's New from Edward Valves

New Products . . . Solutions to Problems . . . Information on Steel Valves from Edward, Long-Time Pioneer in the Field!

HOW TO SELECT FORGED STEEL VALVES

When you need forged steel globe or angle valves (2½" and smaller) for high-pressure and/or high-temperature applications, you can save money on your installations as well as reduce future maintenance expense by making sure you select the proper valve. Here are a few suggestions.

VALVE CONSTRUCTION DETAILS
(See large illustration, opposite page)

Valve Handwheel or Handle should be large enough to operate valve easily. Wheel spokes help keep handwheel cool. Knobbed design permits tight grip even with greasy gloves. Impact type handle will be helpful in obtaining tight closure for valves 1½ to 2½ in.

Yoke Bushing material should be checked. High-strength aluminum bronzes are usually best. Look for ample thread engagement between bushing and yoke and between bushing and stem.

Gland-Stuffing Box—Stuffing box with bolted gland assures good packing compression; hinged bolts swing out of the way but don't get lost. Be sure to get stainless steel bolts for maximum resistance to rusting, and for easy adjustment even after years of service. Packing chamber should be deep and not excessively wide.

Bonnet Joint of bolted construction is easiest to work with. You can disassemble and reassemble with pocket-size tools. Union bonnet is compact and usually less expensive for smaller valve sizes, but is not recommended for high temperatures. Bonnet gasket of soft iron performs well in most services but spiral wound metallic-asbestos gaskets are superior in high temperature services. For extreme pressure-temperature services welded bonnet joints for permanent tightness are desirable. Seal-welded type bonnet has advantage over fully welded design because it permits disassembly and reassembly.

Seat-Disk Joint—An integral hard-faced seat is generally regarded as superior to screwed seat construction because it eliminates body-seat leakage and retains hardness under temperature. A hard faced disk or disk of special alloy is desirable in high temperature services; but 13 per cent chromium stainless steel is an excellent all purpose material below 750 F.

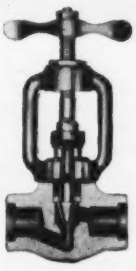
Other Features to Evaluate—Valve compactness is important because you frequently find small piping located in crowded quarters. Inclined bonnet globe valves are less likely to erode due to high velocities—have less pressure loss. Valves of "inside screw" design (stem threads below packing chamber) are usually lower priced and give good service where temperature is not too high and where line fluids are free of sediment. But, best design and materials are useless without experienced workmanship and rigid quality control.

VALVE APPLICATION SUGGESTIONS
First, determine whether a standard valve will do the job before ordering expensive special designs. (Your Edward Representative can help you decide.) Often a slight modification of a standard valve, or a combination of standard valves, will do the job. Here are some facts about types of standard valves and their application:

- For many services, angle valves (illustrated by valve #1) reduce installation cost, minimize pressure drop, improve operational convenience. All Edward forged steel stop and stop-check valves from ¼" to 2½" sizes are available in the angle version.
- For high temperature, Edward forged steel valves with seal-welded bonnets (#2) permanently maintain pressure tightness without periodic tightening of bonnet joints.
- For blow-off service, or wherever double valving is required, select sets of valves of the same basic type with hard-faced seating surface for dependability, longer life and interchangeability of parts (#3).
- For permanent tightness, select an instrument valve (#4) with corrosion-erosion resistant hard-faced seat or a valve with stainless steel body. Bonnetless design requires less maintenance.
- Piston-type check valve (#5), available with union, bolted, or seal-welded cover, is best for most services because it will seat tighter, has easily repairable seat face.
- Modern globe and angle stop valves (shown here) are more dependable than gate valves where repeated drop-tight closures are required, may be used for approximate flow regulation and moderate throttling.

YOUR EDWARD REPRESENTATIVE will be glad to give you the complete story on these features, plus the many other advantages of Edward valves—such as positive, pressure-tight backseats, self-centering disks, special stem and packing materials, and many others. Edward builds a complete line of cast and forged steel valves for pressures to 10,000 lbs. For additional information write to Edward Valves, Inc., 1230 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St., W., Montreal 1, Quebec.

4 INSTRUMENT VALVE—Fig. 952Y, 600 lb or 2500 lb at 850 F (6000 lb WOG) with swing bolted gland, socket welding ends, no bonnet joint. Sizes ¼" to 1".



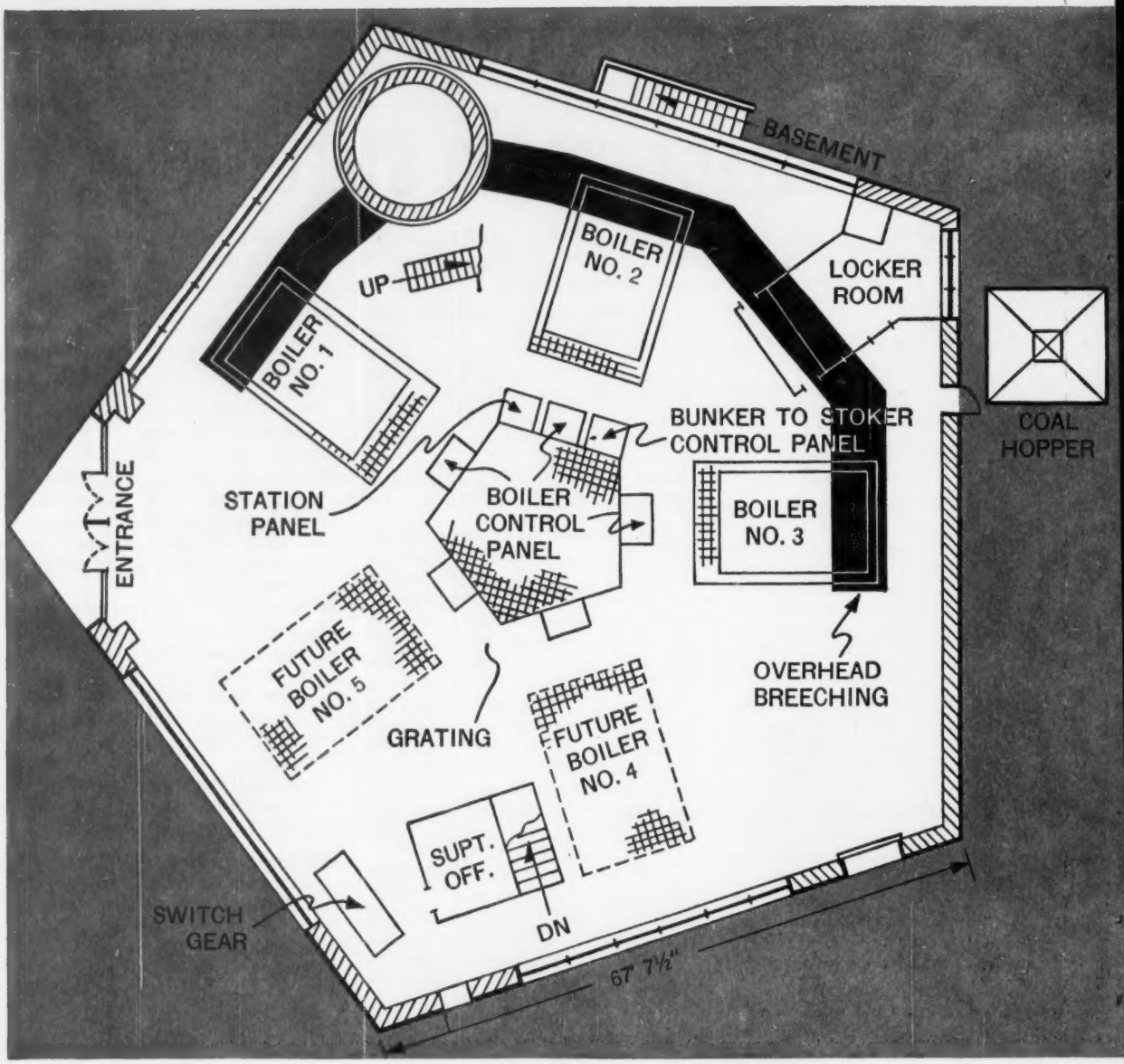
5 CHECK VALVE—Fig. 5538, piston type, 1500 lb at 1050 F (3600 lb WOG) bolted bonnet, screwed ends, integral Stellite seat. Sizes ¼" to 2".

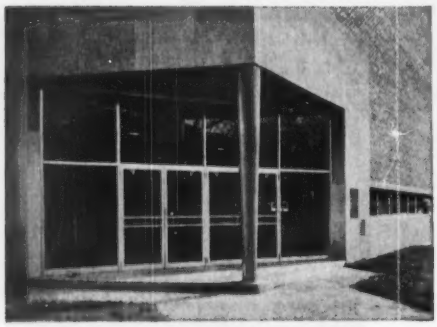
*T. M. Reg. U. S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

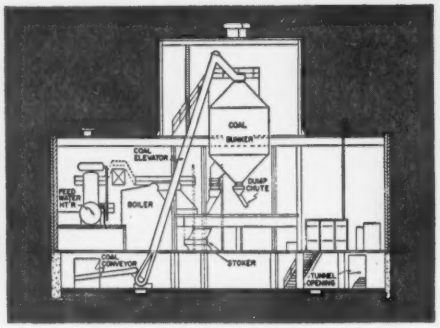
Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18", in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

For more facts circle 214 on Reader Service card, p 99





Entrance to unusual "little Pentagon" structure. This shape gives maximum space utilization and allows one-man central control of all boilers. Construction provides comfortably for three 31,000 lb/hr boilers and allows for two similar units in the future, within 7,000 sq. ft.



Elevation shows how coal moves from incoming conveyor by 25 ton/hr. Stephens-Adamson Redler elevator to overhead bunker (capacity 125 tons). Coal feeds from here to scales, then directly into stokers. Bunker and scales by Beaumont Birch Co.

Coal is brought in by rail and unloaded into track hopper. From here, a Stephens-Adamson conveyor carries the coal into the plant and internal coal handling system.

Hospital cures fuel ills with "little Pentagon"

Richmond State Hospital burns coal for economy and availability in modern pentagonal power plant

After a power system failure at the Richmond State Hospital, Richmond, Ind., the administration conducted an engineering survey of its steam-generating operation. Over-age equipment indicated the need for entirely new facilities. The shape of the boiler room site prompted the unconventional pentagonal installation for best possible adaptation of space to present and future needs. *Economy* and *availability* dictated the choice of coal as the fuel.

Today a new power plant—designed by Fleck, Quebe and Reid, Indianapolis, with F. B. Morse, of Purdue University—burns coal in a completely modern, automatic operation. The outstanding features of this compact installation are its high combustion efficiency, minimum manpower requirements and continuing ease of maintenance.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% *more* steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

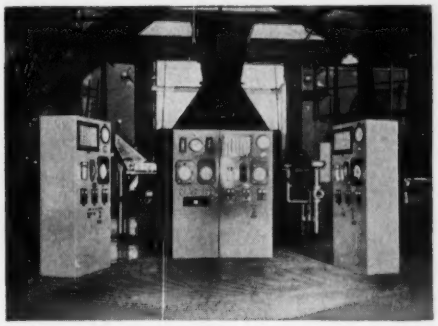
Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

BITUMINOUS COAL INSTITUTE

Department P-07, Southern Building, Washington 5, D. C.

See our listing in *Sweet's*



Shown are three Henry Vogt boilers, fed by Laclede chain grate stokers, with individual control panels. Controls are pneumatic type, by Copes Vulcan. From boilers, ashes are moved pneumatically by United Conveyor Ash handling system to silo for disposal.

SEND COUPON FOR NEW BCI PUBLICATIONS. Guide Specifications, with complete equipment criteria and boiler room plans:

BITUMINOUS COAL INSTITUTE
Southern Building, Washington 5, D. C. P-07

Gentlemen—please send me:
☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker); ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker); ☐ GS-3 (automatic package boiler for heating and process plants). ☐ Case histories on larger plants.

Name.....

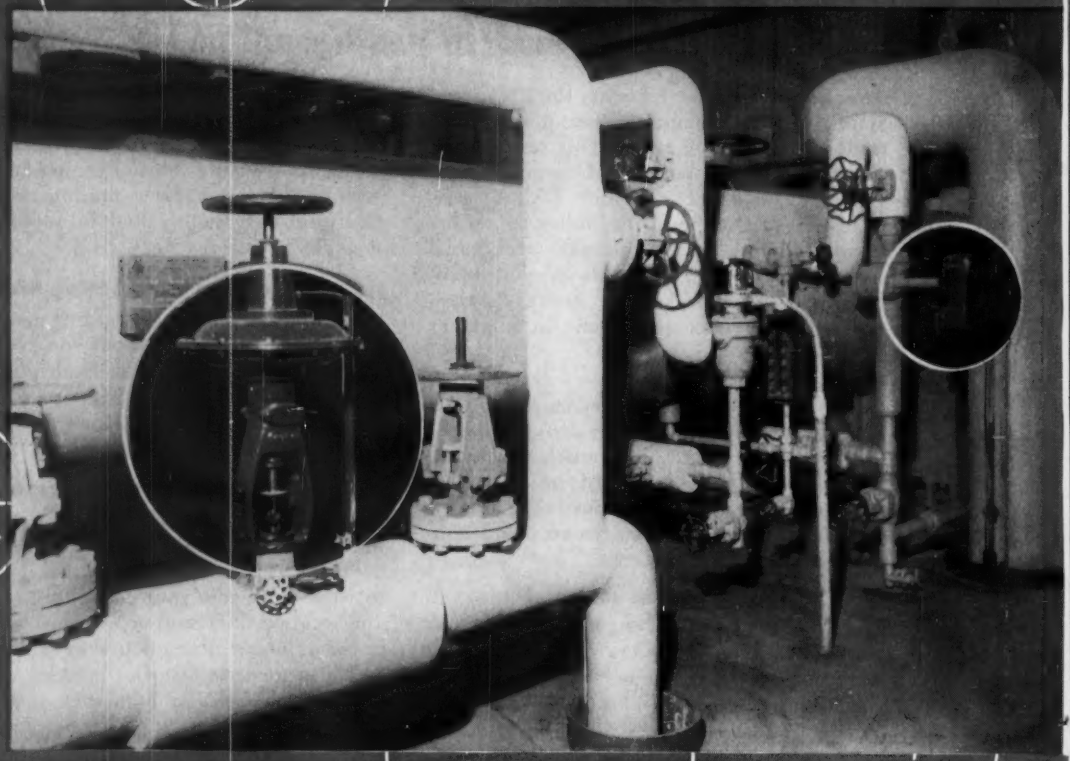
Title.....

Company.....

Address.....

City..... Zone..... State.....

MASONEILAN CONTROLS PROVIDE NEEDED FOR MODERN



This is a Masoneilan Control Valve and Liquid Level Control in [illegible] exchanger service at a [illegible] power plant.

TYPICAL APPLICATIONS

- Feed Water Recirculating
- Desuperheater Temperature and Pressure
- Turbine Bypass, Reheat and Exhaust to Process
- Condenser and Deaerator Level
- Heater Drains
- Reducing Stations

DEPENDABILITY, FLEXIBILITY POWER PLANT ECONOMY

Masoneilan Control Valves, Liquid Level Controls and Butterfly Valves provide optimum control of temperature, pressure and liquid level to help meet today's demand for more efficient generation. Masoneilan equipment has established an outstanding record for dependability, and contributes important savings because of long service and simplified maintenance.

- **Control Valves . . .**
  Globe, angle or three-way valves designed to provide accurate, positive response to controller signal. Equipped with powerful actuators for precise plug positioning and built with maximum stamina.
- **Liquid Level Controllers . . .**
  A versatile line of controllers — designed for all types of fluid handling systems. Features include a wide selection of ranges and pressure ratings, and a variety of materials and mounting types to meet all conditions. Includes control types for special applications.
- **Butterfly Valves . . .**
  Today's most modern line of butterfly valves. Wide variety of actuators. Used for handling large volumes of water in condenser service, pump discharge or other power plant applications.

If your job involves selecting controls for fluid handling, it will pay you to get complete information on Masoneilan equipment. For free literature and technical assistance contact your representative or write direct.

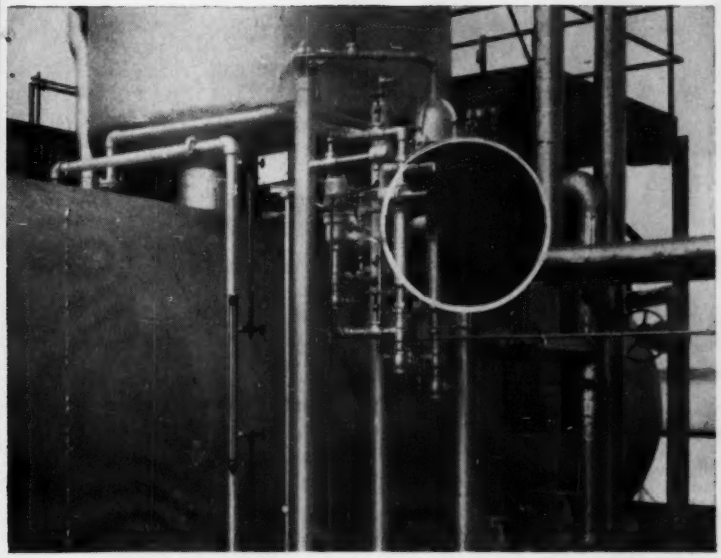
ALL HIGH Quality Coefficient PRODUCTS

MASON-NEILAN

Division of Worthington Corporation

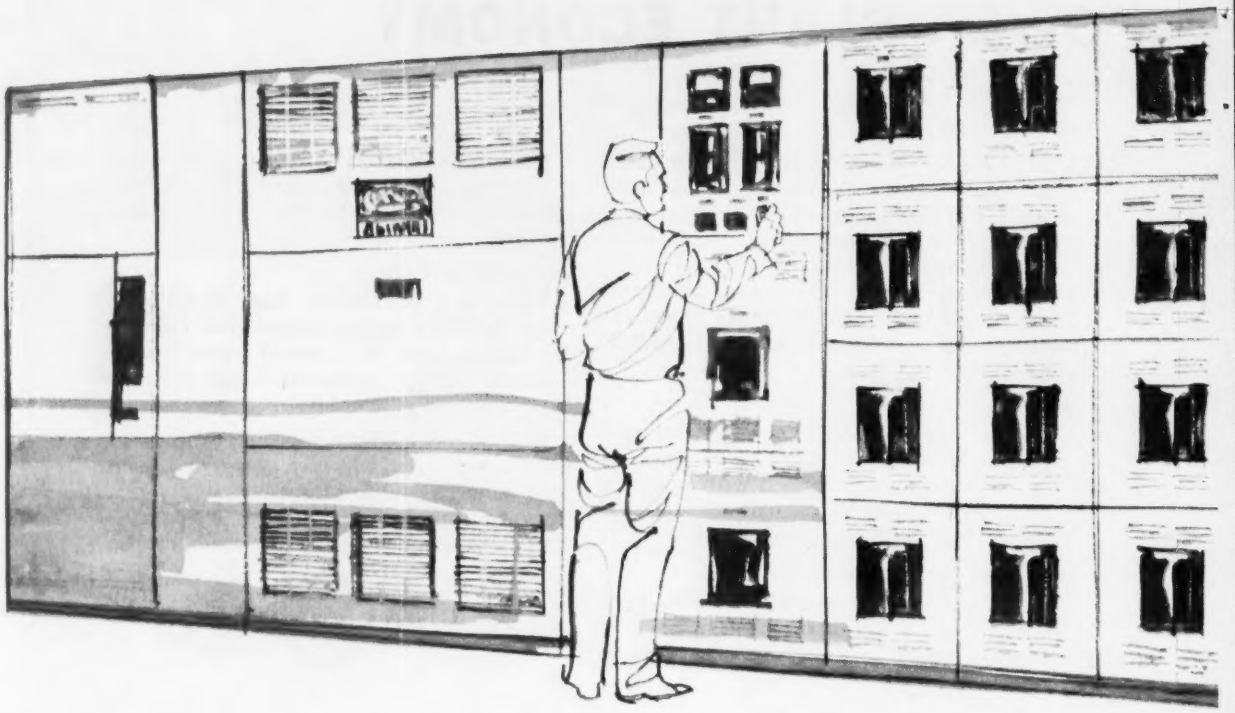
33 NAHATAN STREET, NORWOOD, MASSACHUSETTS

District offices or Distributors in principal cities in U.S.
In Canada: Mason-Neilan, Division of Worthington (Canada), Ltd.



America's historic Atomic Power Plant at Shippingport, Pa. uses these Masoneilan Control Valves for Flash Tank Surge and Blow-Off Tank.

Masoneilan Liquid Level Controls in Deaerator Service at a southern power plant.



SAVE

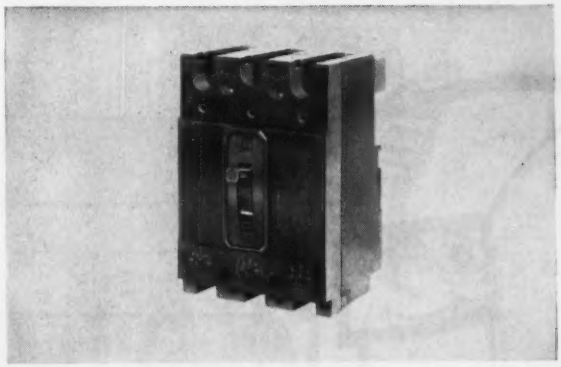
Buy your power at lower cost. Bring it right to your large load areas at economical higher voltage. Save on the cost of your cable conductors. Then get the extra secondary unit substation advantages only I-T-E offers.

I-T-E saves you time. Because only I-T-E designs, fabricates and assembles complete unit substations in one plant. They are shipped all at one time and on one date, timed to mesh with your own construction schedule. So you save valuable construction time.

I-T-E saves you the risk of operating trouble. Transformer engineers and switchgear engineers coordinate their efforts to insure harmony of design. They work with manufacturing people to insure proper construction. They supervise final tests to insure proper performance.

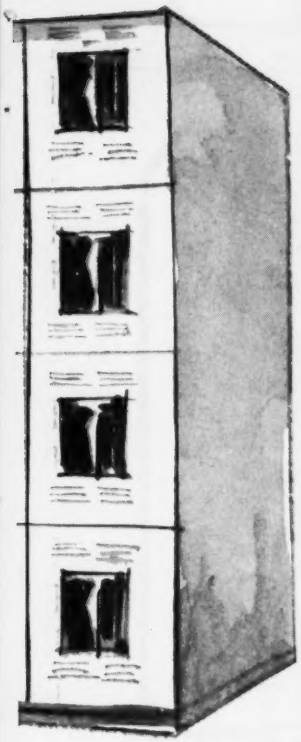
I-T-E saves you installation costs. I-T-E substations are completely assembled on the I-T-E floor before shipped. This insures that all holes line up. Hardware is provided. So when equipment reaches your plant, you are better protected against costly installation delays.

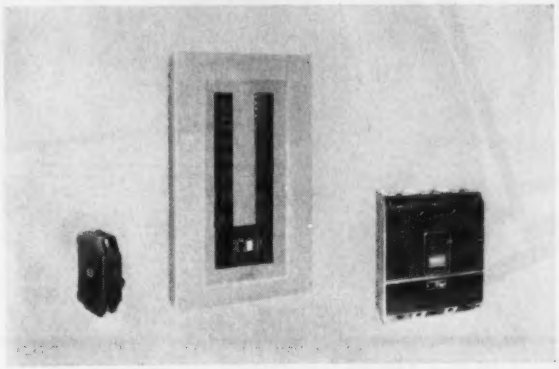
Forethought such as this goes into the design and manufacture of all I-T-E electrical equipment . . . the better to serve you. Good to remember when you get ready to buy.



New 100 amp Type ETI, EH frame, breaker. Here is a new addition to I-T-E's broad line of molded case circuit breakers. It brings economy and space saving for motor control center applications. Available in 2 and 3-pole construction. Type ETI, EH frame, breakers provide the ultimate in motor protection when used in conjunction with a motor-protective relay. The relay protects against overloads. The circuit breaker features pinpointed short circuit trip adjustment with external control previously available only on larger molded case breakers.

Space-saving d-c circuit breakers. A fault on most d-c lines involving large currents could really produce some spectacular results. But I-T-E Model FB d-c circuit breakers interrupt fault currents before they get into the danger area. Opening occurs in roughly 12 milliseconds. Rise rates of even 15 million amp per second are stopped sharp at 60,000 amp. This means extra protection for all associated equipment from damage that even momentary persistence of such high currents could produce. FB circuit breakers are available in either single or double pole. Only 10½ in. wide. Save space. Easy to install.





Preferred by equipment assemblers. Leading independent manufacturers recognize the superiority of I-T-E molded case breakers. And they buy I-T-E most of all. Experience consistently proves that I-T-E's better construction means more dependable performance. Ratings range from 15 to 800 amp continuous . . . the broadest scope of sizes and types in the field. Premium pole spacing eases installation and adds extra safety. Enclosed front-connected pressure terminals accept conductor sizes commensurate with breaker ampere ratings. Convenient externally adjustable instantaneous trip on larger size breakers permits easy, fast setting commensurate with short circuit requirements.

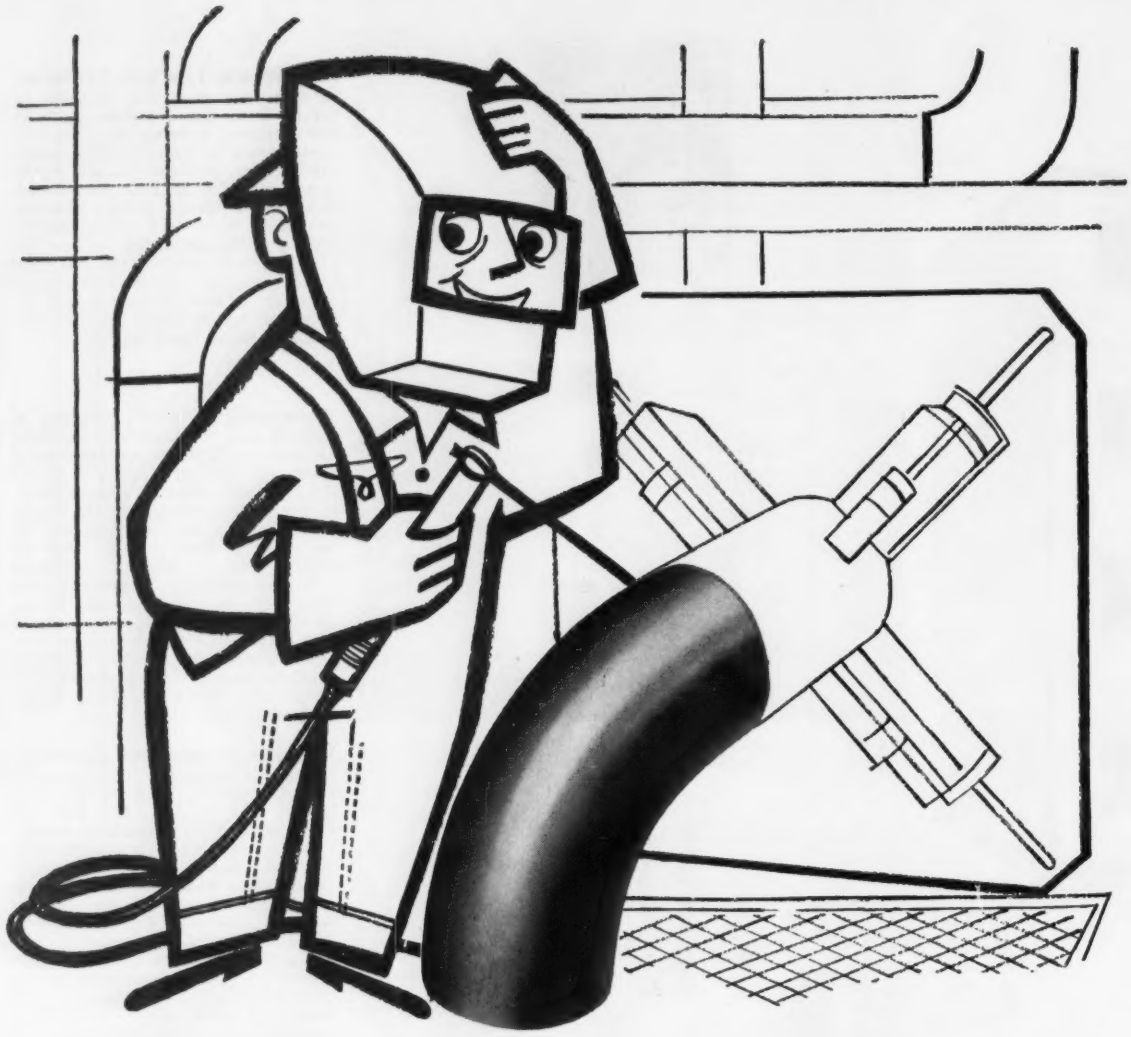
I-T-E Circuit Breaker Company I-3
1900 Hamilton St., Philadelphia 30, Pa.

- ☐ Secondary unit substations
- ☐ Power switching centers
- ☐ Molded case circuit breakers
- ☐ Metal-clad switchgear (4.16 and 13.8 kv)
- ☐ D-c circuit breakers
- ☐ TRANFO-UNITS
- ☐ TELEMAND* motor-operated molded case circuit breakers
- ☐ K-LINE circuit breakers
- ☐ Other_____

Name_____Title_____
Company_____
Street_____
City_____Zone_____State_____
*I-T-E Trademark

SEND COUPON OR WRITE
Get complete, up-to-date information on I-T-E equipment

I-T-E CIRCUIT BREAKER COMPANY



B&W JOB-MATCHED WELDING FITTINGS

make piping pre-fabrication more economical

Dimensional accuracy is the key to economical pre-fabrication and installation of process piping . . . and you get true accuracy with B&W Job-Matched Welding Fittings. This means:

- during fabrication sections can be pre-cut and you know they will fit
- welding time is reduced because there are fewer fit-up problems, eliminating time consuming and costly fill-in welding
- fabricated sections can be installed without delays because each fitting is well within tolerance.

Ask for B&W Job-Matched Welding Fittings through local B&W District Sales Office or any qualified welding fittings distributor, or write for B&W Bulletin FB-504, The Babcock & Wilcox Company, Tubular Products Division, Fittings Department, 3839 West Burnham Street, Milwaukee 46, Wisconsin.

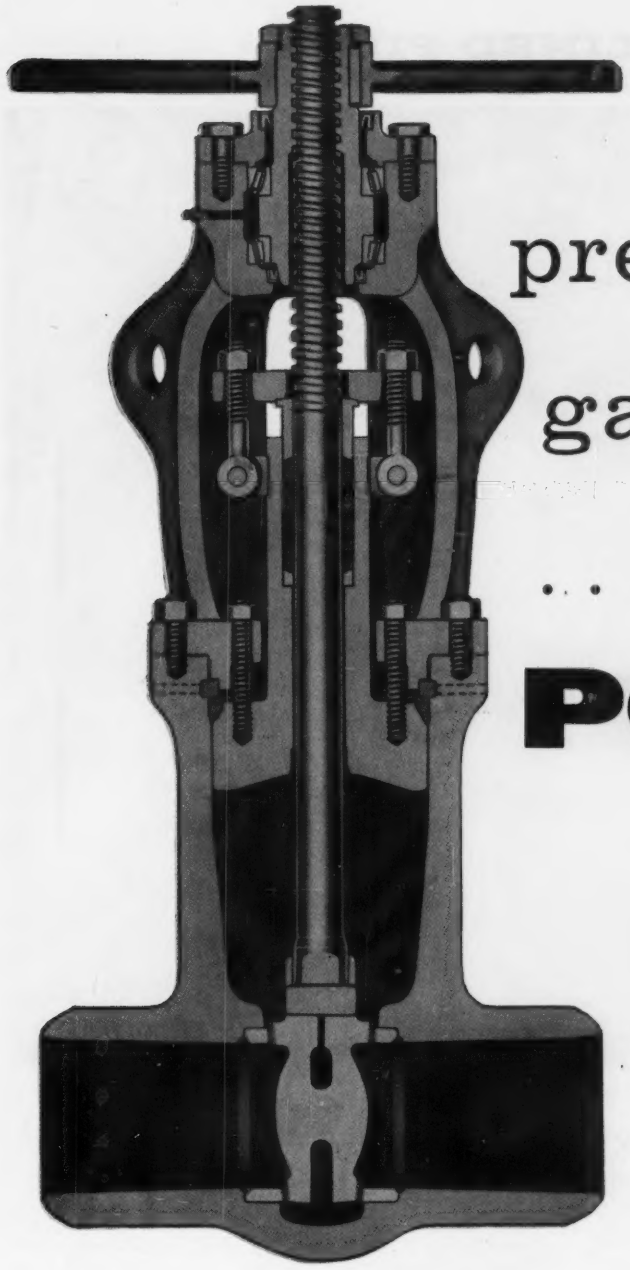
TA 9023 WF1

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION, FITTINGS DEPARTMENT

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals



pressure seal gate valves ... made the POWELL way

600, 900, 1,500, 2,500 Pounds
and Higher—all commercial sizes

Powell Pressure Seal Gate Valves offer many superior features. A few are:

- Streamline flow passage makes possible maximum flow with minimum turbulence.
- Outstanding simplicity of design, smooth body contour and weight reduction assure easier installation, greatly reduced insulating costs, and a marked saving in space.

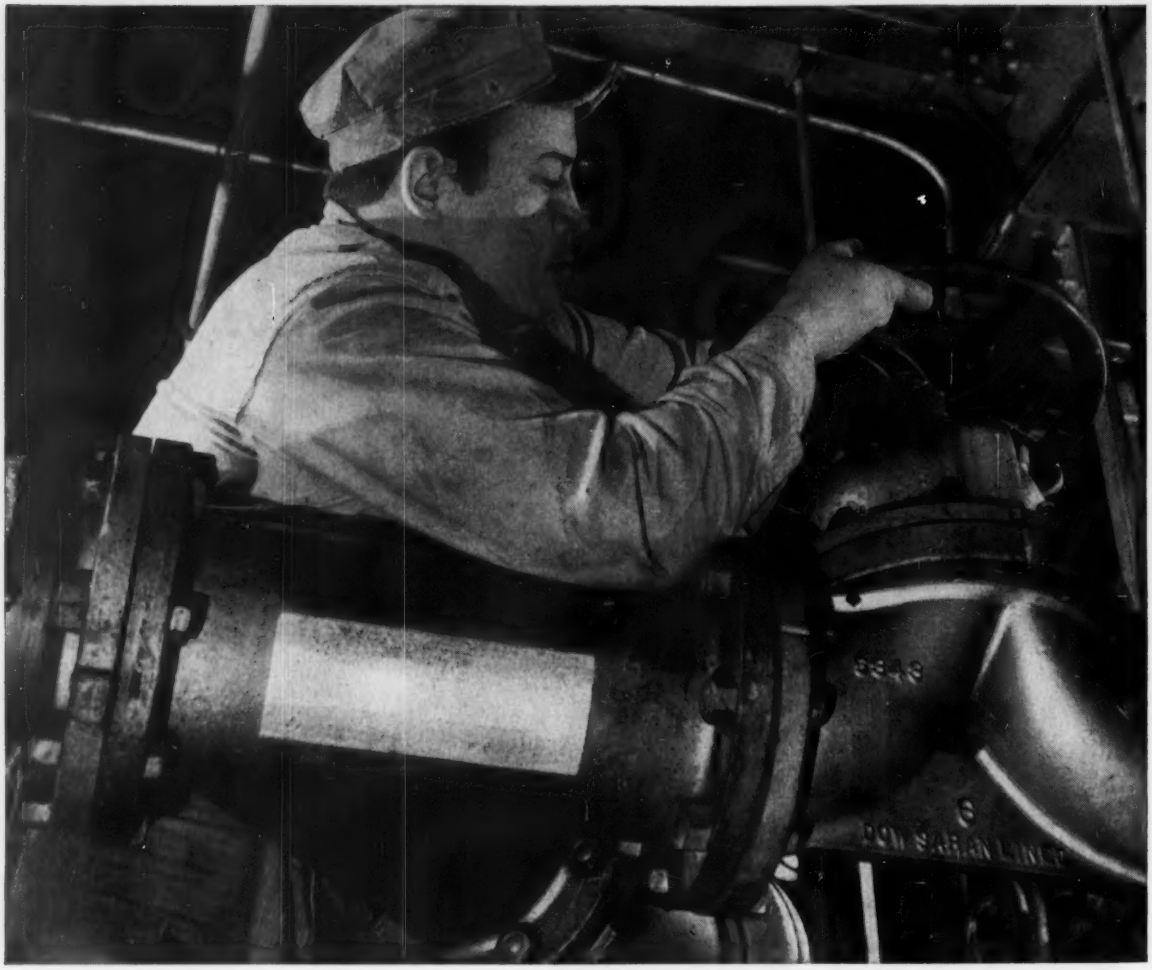
Powell Pressure Seal Valves are also available in Globe, Angle and Check patterns.

For all your valve needs, consult your local Powell distributor—or write directly to us.

THE WM. POWELL COMPANY
Cincinnati 22, Ohio
Dependable Valves Since 1846

POWELL...world's largest family of valves

DOW | **SARAN LINED PIPE**



After more than 3 billion pounds of acid and alkali solutions
No replacement of corrosion-resistant Saran Lined Pipe

When utility power plant piping must carry six million pounds a day of acid-and-caustic-treated water . . . piping in which a single failure would shut down the entire water-treatment system . . . dependable corrosion resistance becomes a matter of public safety.

Wisconsin Electric Power Company's Commerce Street power plant in Milwaukee furnishes steam for heating a 24 square-block area in downtown Milwaukee. In this plant Saran Lined Pipe is used to carry acid-treated and caustic-treated city water to cation and anion tanks for demineralization prior to use in the plant's high-pressure steam system. Approximately 725,000 gallons a day of the corrosive liquids pass through the system, one section of which is shown above.

Saran Lined Pipe was first installed in this power plant 2½ years ago. Since that time, despite a total volume flow of over *THREE BILLION* pounds, there's never been a replacement of the Saran Lined Pipe. Mr. Fred H. Long, Chief Chemist of Power Plants for the company, stated that an additional advantage of Saran Lined Pipe is ". . . we find that the pipe is relatively easy to cut to proper length. We don't have to order exact pre-cut lengths, then wait for delivery. This also . . . looks like the best type of pipe we've tried for resistance to corrosion and ease of maintenance.

Whenever piping systems *must* resist corrosion and chemical activity, no matter how extreme the conditions, it'll pay to specify dependable Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can be cut, fitted and modified easily in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2288DW7.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

For more facts circle 220 on Reader Service card, p 99

circle 221 on Reader Service card, p 99 ➤

another G-E
8000
development

GENERAL ELECTRIC ANNOUNCES . . .

New Custom '8000'* Motors

PROJECT '8000' . . . a major General Electric program of research, redesign, advanced manufacturing and improved customer service on A-c motors 150 to 6000-hp.

*Trademark of General Electric Co.

CUSTOM DESIGNED . . . New General Electric Custom '8000' motors are built specifically to meet your requirements. Selecting from specially designed enclosures, advanced insulation systems, custom-designed end shield and bearing constructions, and more than 15 custom-designed accessories—plus a countless number of electrical designs—General Electric engineers will create a motor to meet exacting needs, provide initial and continuing economy, and give long, reliable service. Turn page for features of new Custom '8000' motors.

NEW CUSTOM '8000' MOTORS GIVE TOP PERFORMANCE WITH LESS MAINTENANCE . . . HERE'S WHY

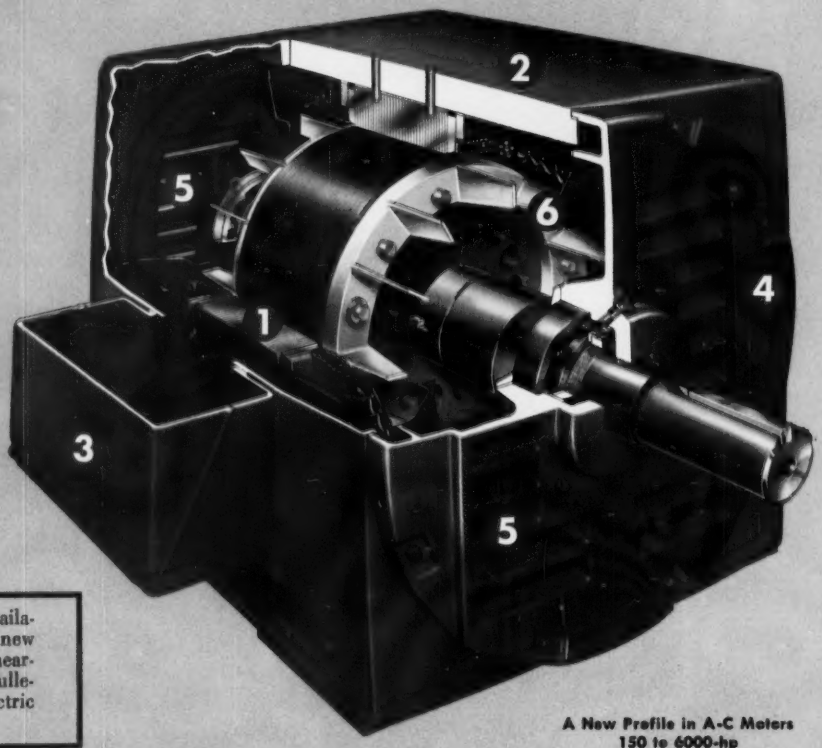
GENERAL ELECTRIC

FROM GENERAL ELECTRIC . . .

another G-E 8000 development

NEW Custom '8000'* Motors Give Greater Reliability Require Less Maintenance

1. **LONGER INSULATION LIFE**—Pre-wound core allows closer quality control and gives longer insulation life through improved varnish impregnation or silicone rubber encapsulation.
2. **BETTER CONSTRUCTION**—Cast iron frame withstands 20G simulated transportation shock tests; resists corrosion.
3. **FASTER INSTALLATION**—Conduit box has up to 3 times volume of ordinary boxes; lifting lugs, cast to frame, hold up to 12 times motor weight.
4. **EASIER MAINTENANCE**—Flat end shields are more adaptable to addition of accessories or modifications; are lighter—easily handled by one or two men.
5. **BETTER COOLING**—Double-end ventilation, new duct design and louvred air openings provide more efficient air distribution through motor, reduce hot spots.
6. **LOWER NOISE LEVEL**—Sound power has been cut up to 50% by redesigning frame sections, rotor fans, air deflectors and intakes.



A New Profile in A-C Motors
150 to 6000-hp

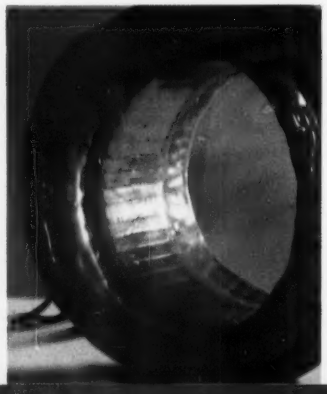
FOR COMPLETE INFORMATION and availability dates about General Electric's new Custom '8000' motor line, contact your nearby Apparatus Sales Office, or write for bulletin GEA-6865, Section 884-2, General Electric Co., Schenectady, N. Y.

NEW *Polyseal** SILICONE RUBBER INSULATION SYSTEM IS AVAILABLE ON CUSTOM '8000' MOTORS

Silicone rubber used in Polyseal insulation systems is a product of General Electric's Silicone Products Dept., Waterford, N. Y. . . . a leader in research, development, and manufacture of silicone materials. Supported silicone tape is a development of General Electric's Insulating Materials Dept., Schenectady, N. Y. Combining silicone rubber with dacron-glass supporting materials is a major engineering advancement, giving this material both the mechanical and dielectric strength required for use as a motor insulation. Polyseal insulation systems are available *only* on General Electric motors. Medium AC Motor & Generator Dept.

FORM-WOUND MOTORS

Polyseal supported silicone rubber insulation system provides greater mechanical, thermal, voltage and environmental endurance than unsupported silicone rubber. Glass fabric materials are imbedded in each layer of silicone tape, which, after coil wrapping is vulcanized under heat and pressure to seal the system against moisture and contaminants. General Electric form-wound open motors with Polyseal insulation system can be used in some severe atmospheres formerly reserved for totally-enclosed motors.



RANDOM-WOUND MOTORS

Polyseal silicone insulation system offers greater flexibility and better heat transfer than existing encapsulations . . . it operates effectively from −90C to 200C and will not crack under excess thermal cycling or severe moisture. After receiving G.E.'s standard random-wound insulation treatments, Polyseal insulation is applied to stator and end turns, completely sealing windings with a thin, waterproof, inert covering which protects against extreme moisture, most chemical fumes, dust and corrosion.

*Trademark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

FAN-STACKS

AIR PREHEATERS

CURTAIN DAMPERS

MECHANICAL DUST COLLECTORS

INTEGRAL DUST COLLECTORS

ELECTRICAL PRECIPITATORS

SERIES DUST COLLECTORS

GAS SCRUBBERS

BLOWERS

AIRCRAFT CONTROLS

AIRCRAFT SEATS

To better serve power plants, aviation and general industry ...four fast-growing corporations merge July 1, 1959

Prat-Daniel Corporation (Established 1924), The Thermix Corporation (1941), The Aerotec Corporation (1942) and The Aerotherm Corporation (1950) are known and respected internationally for their engineering and manufacturing skills.

On July 1 they formed a new, integrated corporation, Aerotec Industries, Inc. — having carefully studied the advantages of centralizing management and consolidating their financial and manufacturing resources. Management of the new organization remains in the hands of the experienced executives of the merging companies.

The new Aerotec Industries, Inc. has three divisions:

The **Industrial Division** engineers, manufactures and sells electrical precipitators and mechanical dust collectors for flyash and industrial applications, as well as air preheaters, curtain dampers, blowers and fan-stacks. Its facilities include a plant in Greenwich, Conn., and the Prat-Daniel plant in South Norwalk, Conn.

The **Aircraft Equipment Division,** Greenwich, Conn., designs, produces and sells a wide range of controls for aircraft, missiles and nuclear applications.

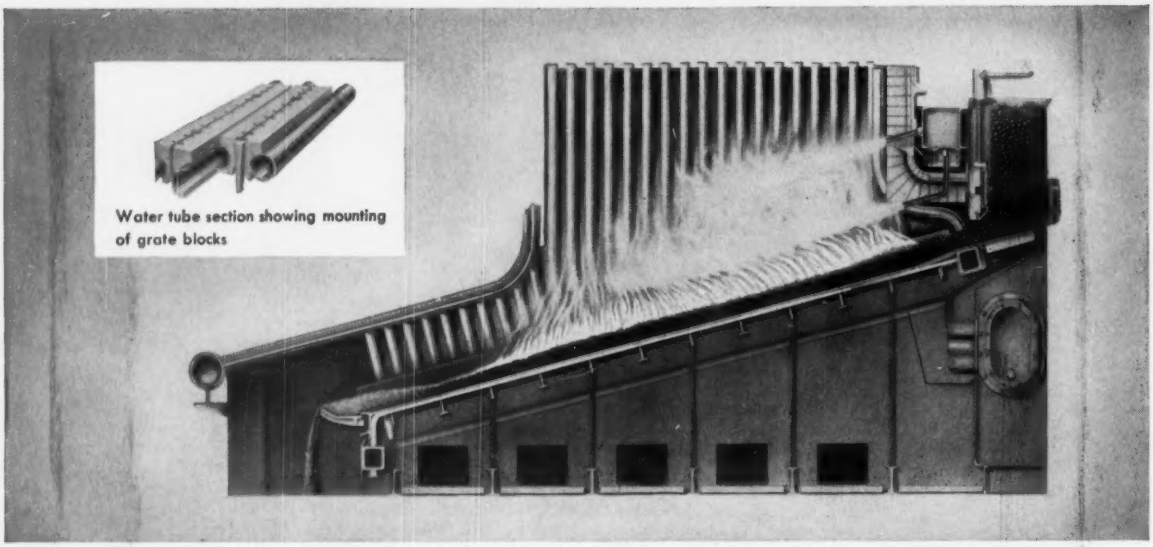
The **Aerotherm Division,** Bantam, Conn., develops, fabricates and sells aircraft seating and accessories.

An expanded and intensified program is now underway to accelerate research, new developments and technical advances that will benefit you. If you have any problems or requirements in the above fields our engineers are ready to help solve them.

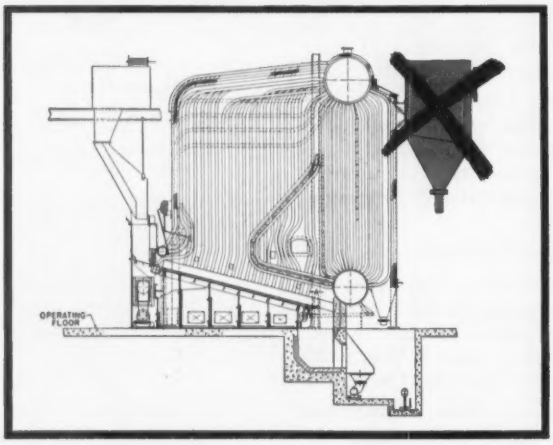
Write Aerotec Industries, Inc., Dept.-P, Greenwich, Conn.

For more facts circle 222 on Reader Service card, p 99

Only AE Vibra-Grate Stokers give you these 3 important benefits



Water-cooled grates. Water-cooling . . . directly connected to the boiler circulation system . . . guarantees the longest grate life available in any stoker today. Proven maintenance costs are less than one cent per ton of coal. In fact, one major installation has used less than $200.00 worth of repair parts in over four years of continuous operation!



Elimination of dust collectors and cinder return systems. Vibra-Grate burns the coal on the grate . . . dust collection and cinder return systems are not needed. You will never have to be selective in the grade of coal you burn either. Vibra-Grate feeds wet or dry fuel, high or low grade coals. It can burn gas or oil singly or in combination with coal. Overfire air assures complete combustion, giving absolute freedom from smoke at high or low ratings.

Higher efficiency. Intermittent vibrating motion of the grate feeds and moves the fuel . . . insuring even, compact distribution on the bed. A combustion-controlled electric timer determines the vibration frequency as required by fuel and steam demand. There are no light spots or holes to reduce efficiency. The grate supports form air-tight zoned sections dampered to permit accurate regulation of undergrate air.

THE AE VIBRA-GRATE offers advantages in stoker operation and efficiency that have never been available before, because it is the only stoker which combines the maintenance saving features of water-cooling and the high efficiency features of a vibrating grate and controlled zone undergrate air. Only from Vibra-Grate can you get such dramatic reductions in maintenance costs . . . as well as efficiencies that can't be equalled. Write for complete information on what Vibra-Grate stokers can do for you in terms of lower operating costs. American Engineering Company, Dept. S-100, Philadelphia 37, Pa.

AMERICAN ENGINEERING COMPANY
Wheatsheaf Lane and Sepviva Street • Philadelphia 37, Pa.
Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P. Q., Bawden Industries Ltd., Toronto, Ont.

For more facts circle 223 on Reader Service card, p 99

FISHER "HH" 2500 lb. A.S.A. BODIES

for HIGH PRESSURE AND TEMPERATURE SERVICE

CALL YOUR *FISHER/MAN*

Guides and bushings are Stellite faced to prevent seizing or galling. Guide posts are made extra large. This extra protection means longer life.

CALL YOUR *FISHER/MAN*

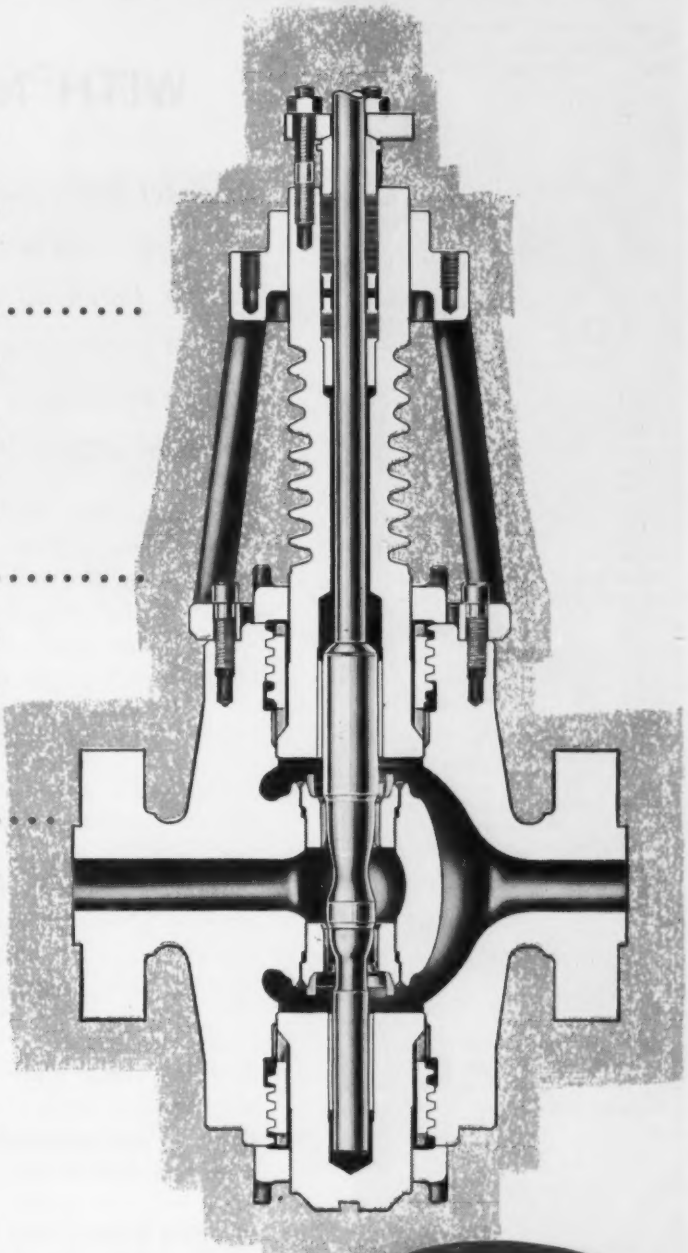
Screwed-in seat rings are Stellite faced to eliminate erosion and wire drawing. Fisher seal welds them in place to keep rings from working loose and to prevent leakage past the threads.

CALL YOUR *FISHER/MAN*

Available in single or double ported body designs—one and two inch sizes in the single ported and two, three and four inch sizes in the double ported design.

CALL YOUR *FISHER/MAN*

Use of a pressure sealed bonnet eliminates need for heavy, cumbersome flange heads. Head construction with or without cooling fins is available.



CALL YOUR *FISHER/MAN*
or write FISHER GOVERNOR COMPANY for complete information and literature.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

FISHER GOVERNOR COMPANY

Coraopolis, Pennsylvania / Woodstock, Ontario / London, England

MAIN OFFICE AND PLANT — MARSHALLTOWN, IOWA

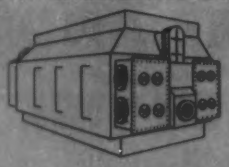
FISHER® Control

SINCE 1880

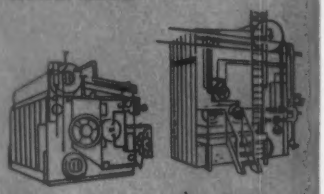
For more facts circle 224 on Reader Service card, p 99

Power Plant Products

HEAT ENGINEERED BY FW



CONDENSERS and HEATERS—Condensers custom designed for individual plant requirements. All-welded high and low pressure feedwater heaters.



PACKAGED and FIELD-ERECTED BOILERS—Compact, economical, standardized units in capacities from 10,000 to 450,000 lb/hr, oil, gas or pulverized coal fired.

LARGE STEAM GENERATORS—Designed to meet all requirements for Central Station or Industrial power plants, in single- or twin-furnace designs, with or without reheat or dual circulation.

COOLING TOWERS—Induced draft counter flow towers of all-redwood construction for maximum dependability and long service.

NUCLEAR COMPONENTS—Heat exchangers, steam generators, pressurizers, reactor vessels, separately-fired superheaters for stationary and marine power plants.

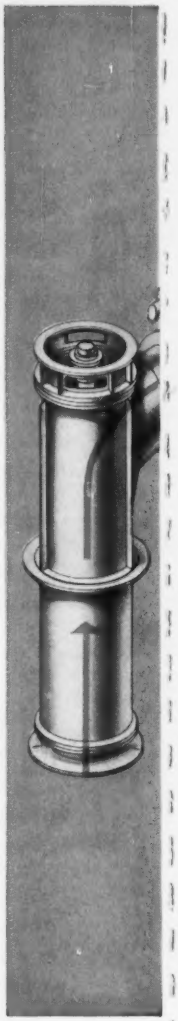
PULVERIZED FUEL SYSTEMS—Completely engineered systems utilizing FW ball mill or MB planetary roll and table pulverizers.

HEAT ENGINEERING

SIMPLIFIES LAYOUT and

WITH NEW SINGLE-PASS,

Compact shells use economical short tubes, eliminate two waterboxes, simplify valving. Balanced back pressure and built-in backwashing system offer further advantages for Alabama Power Company's Barry Steam Plant, Unit No. 3.



Problem: Alabama Power Company and Southern Services, Inc., Engineers, specified that the dual exhausts of the 225,000 kw turbine be handled with condenser tubes at right angles to the turbine shafts —in the tight confines of a plant extension for Barry Steam Plant, Unit No. 3.

Solution: Heat Engineering by Foster Wheeler

By application of the established principles of Foster Wheeler condenser design, a most economical arrangement for a twin bottom-exhaust turbo-generator set with tubes at right angles to the turbine shafts was provided. It features short tube lengths, complete backwashing and a minimum number of waterboxes for a twin-shell design.

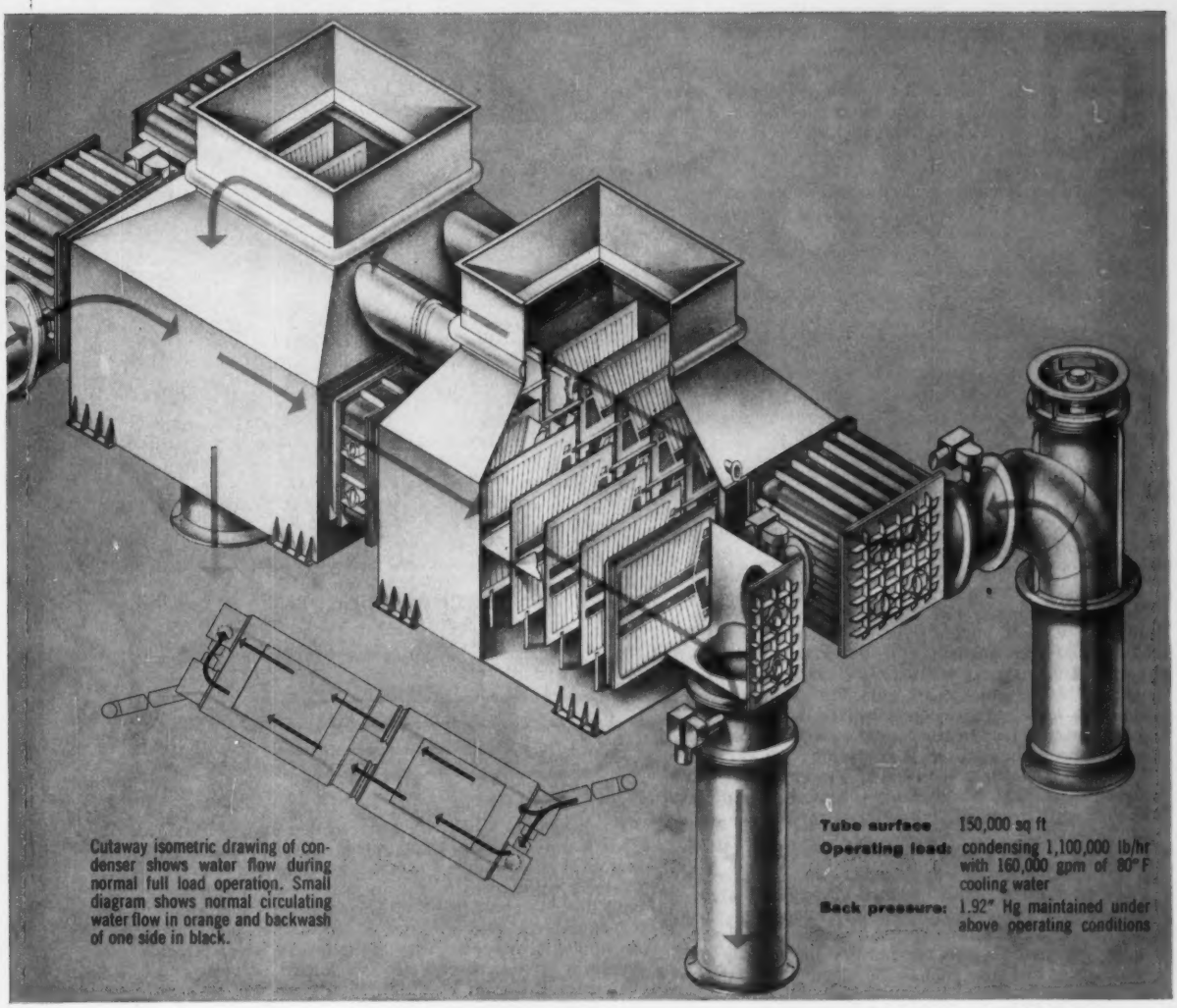
Backwashing of the tube sheets is obtained with only six valves, two of which are the normal circulating pump shut-off valves. This valving arrangement also allows the complete condenser to be operated at light loads with only one circulating pump.

In design advances such as this, you see Heat Engineering at work. This is the concept you can expect—combining new and original ideas with proved engineering principles—when Foster Wheeler serves you. *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.*

BY FOSTER WHEELER

REDUCES CONDENSER COSTS

COUNTER-FLOW DESIGN



Cutaway isometric drawing of condenser shows water flow during normal full load operation. Small diagram shows normal circulating water flow in orange and backwash of one side in black.

Tube surface 150,000 sq ft

Operating load: condensing 1,100,000 lb/hr with 160,000 gpm of 80° F cooling water

Back pressure: 1.92" Hg maintained under above operating conditions

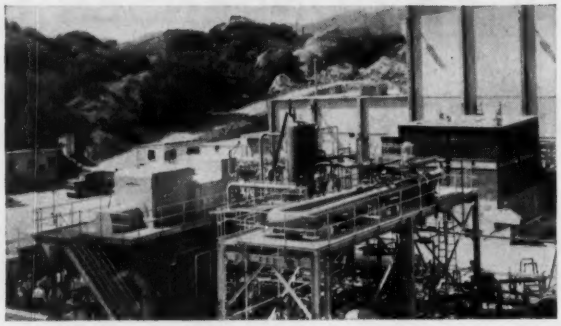
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

For more facts circle 225 on Reader Service card, p 99

Chemical Control Program For A Once-Through Superheated Steam Generator

System Cleaning, Start-Up and Analytical Techniques for Unique Steam Generator Heated by Sodium Reactor



Known as the Sodium Reactor Experiment conducted for the Atomic Energy Commission by Atomics International, and located in the hills thirty miles northwest of Los Angeles, this installation is full of "firsts" and "never befores." Prominent among them is the Southern California Edison Company's steam electric plant including a once-through superheated steam generator, producing 7,500 EKW from 77,500 lbs. of steam per hour at 620 p.s.i.a., 825°F.

Heat is transferred from the nuclear reactor to the steam generator via two separate liquid sodium circuits. The two circuits are separated by an intermediate heat exchanger to avoid radioactivity in the steam generator circuit. Liquid sodium reaches the steam generator at 900°F; returns to the primary exchanger at 440°F.

Water/steam tubes of the generator are each 80 feet long, curved into a U-shaped bundle as shown below, and in the photo at upper right. These tubes are enclosed in concentric tubing containing mercury to prevent any possible contact between the liquid sodium and water or steam (diagram at right).

The entire steam generator is built as a single unit, so repair or internal difficulties caused by deposits or corrosion would create major down-time and maintenance problems . . . which is the point Nalco Consulting Services enter the picture.

Severe Basic Requirements

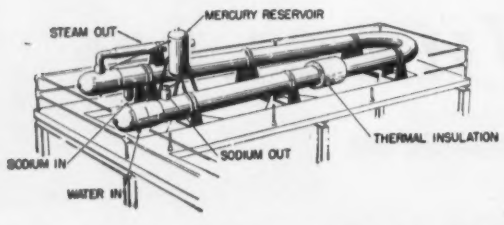
Nalco consultants, working closely with Southern California Edison engineers, determined that permissible dissolved solids in the boiler water should not exceed 0.5 p.p.m., with the following operating range: .001-.003 ppm O_2; .01 ppm Fe; .01 ppm Cu; .02 ppm Cl. Demineralization is utilized for feedwater preparation, and part of the condensate can be passed through the demineralizer if contamination occurs.

The job for Nalco was to set up proper analytical control procedures and methods to assure operation well within the permissible operating ranges.

System Cleaning

Prior to start-up, Nalco set up a complete, step-by-step procedure for cleaning the steam system. As noted above, the single-unit steam generator interior is not only inaccessible for normal inspections or maintenance, but also had to be cleaned for initial operation "by remote control." Testing procedures and analytical methods used as recommended by Nalco at this stage were critical to subsequent successful operation. They worked.

STEAM GENERATOR

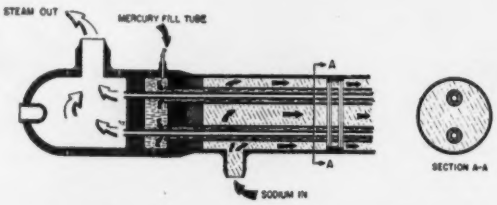


Information Programming

Setting up a sensible information program for this unique installation produced problems hinging on: "What do we *need* to know?" and "What analytical procedures can be used to assure adequate information and accuracy without excessive time and complexity?"

Dealing in impurity limits which would normally be considered "below zero," and with the possibility that entirely new problems could develop in operation, the information and analytical procedures devised by the Southern California Edison-Nalco team are producing data on performance and internal conditions which are accurate, adequate guides to successful operation.

HEAT EXCHANGER CUTAWAY



It is unlikely that your project or problem directly parallels the Sodium Reactor Experiment. However, Nalco's willingness to tackle new areas of research and development, using an unsurpassed background of experience and abilities in specialized chemical technology, may be very valuable to you. Nalco Bulletin D1 describes Nalco Consulting Services and Contract Research in detail. Your copy will be sent promptly at your request.

National Aluminate Corporation is now

NALCO CHEMICAL COMPANY

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For more facts circle 226 on Reader Service card, p 99

circle 227 on Reader Service card, p 99

ELECTRODYNE®

AUTOMATIC VALVE CONTROLS

. . . now a product of HUPP

Pioneered and Produced for Over 35 Years by... CUTLER-HAMMER VALVE CONTROL

HUPP Aviation Company is pleased to announce its purchase of the Valve Control Division of Cutler-Hammer, Inc. of Milwaukee.

HUPP is now manufacturing valve control units in its Chicago plant, under the new name of *Electrodyne Automatic Valve Controls*, and assumes full responsibility for parts and service on the thousands of Cutler-Hammer units now in operation. *Electrodyne Valve Controls* are competitively priced and adaptable to any make and size of valve.

HUPP *Electrodyne Valve Controls* are sold through a nation-wide organization of factory-trained manufacturing representatives who are fully qualified for field service.

Write for prices and other data on *Electrodyne Valve Controls*. Information will be furnished promptly by the HUPP representative in your area.

ELECTRODYNE DIVISION

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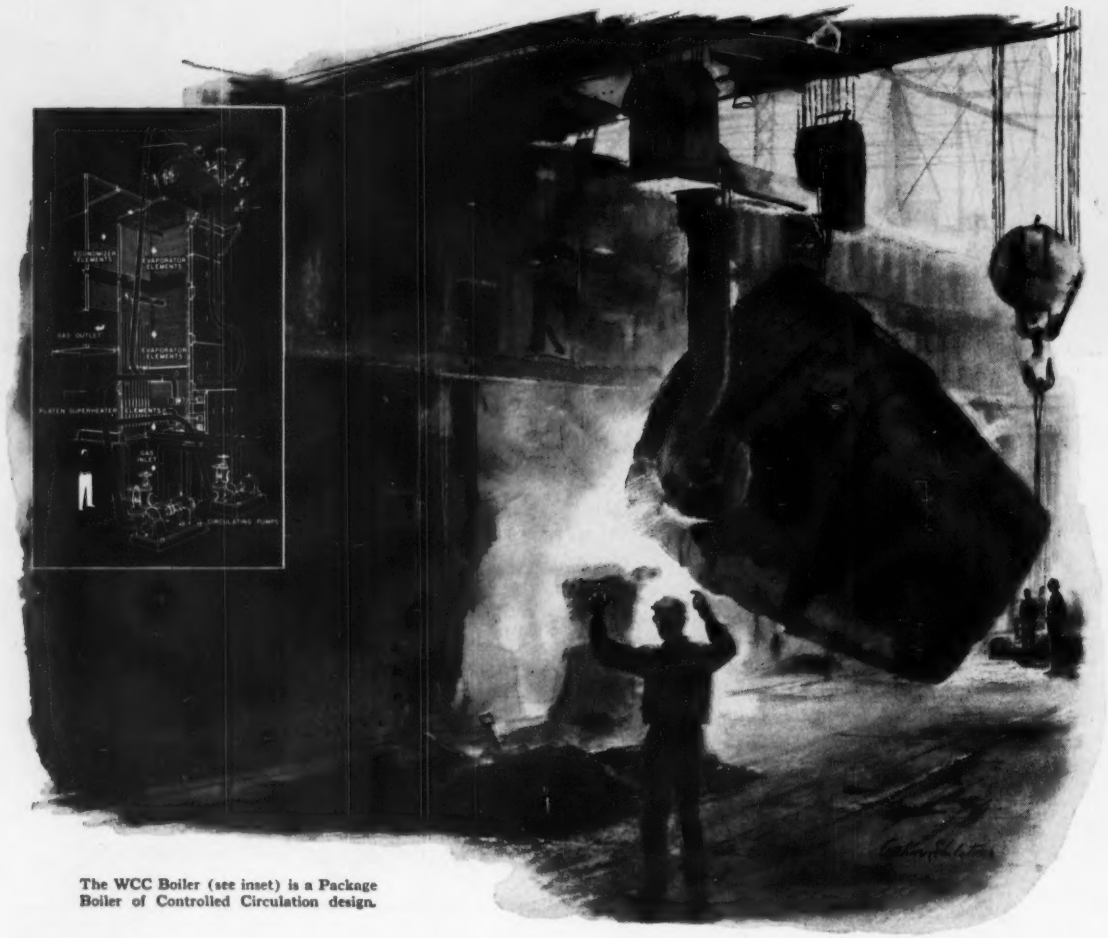
ELECTRODYNE VALVE CONTROLS...HYDROID GEAR PUMPS AND MOTORS...PRECISION INDUSTRIAL, AIRCRAFT AND MISSILE GEARING AND COMPONENTS

WASTE HEAT AND BY-PRODUCT STEAM WHEN

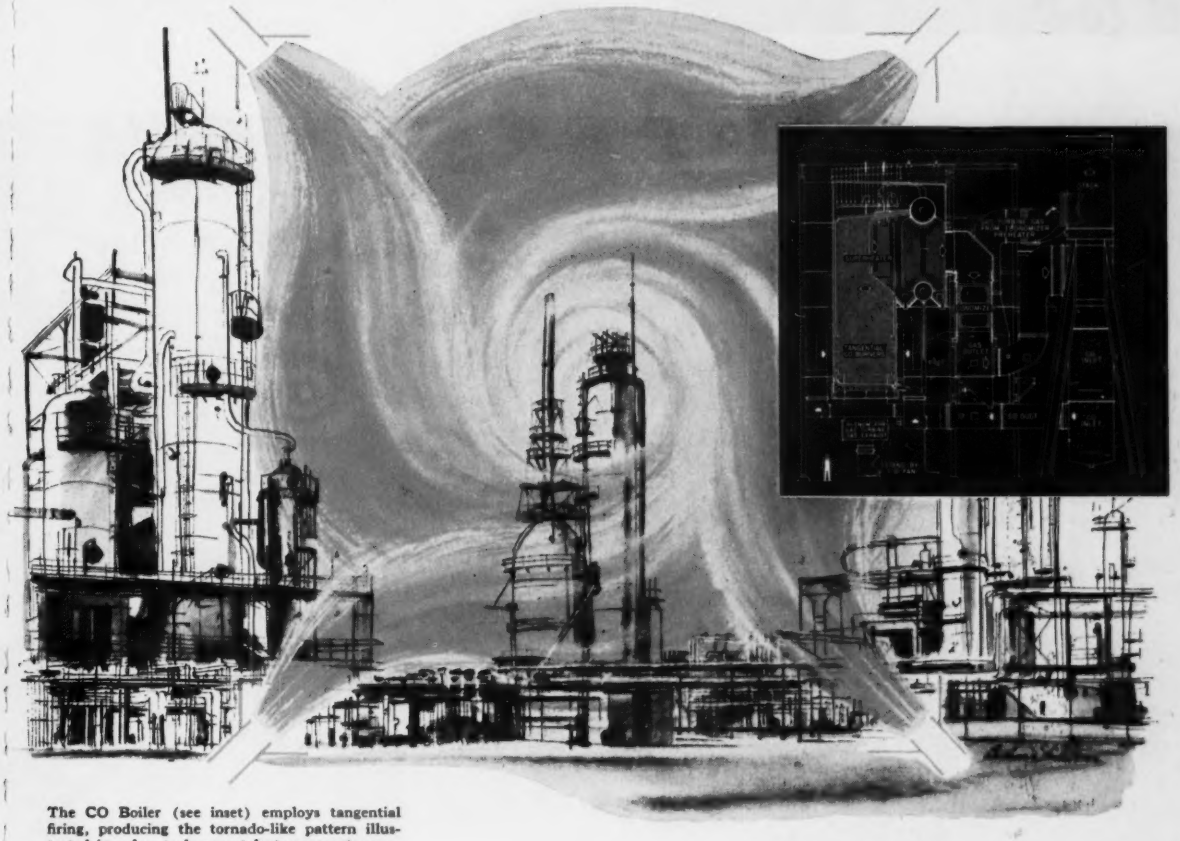
Though no two industrial processes are exactly alike, a great many produce hot waste gases or by-product waste materials. Often, they contain substantial amounts of energy which, when properly used, can provide a valuable addition to the fuel supply of a plant. C-E has had long and varied experience in taming and harnessing many kinds of waste and marginal fuels. At the steel mill pictured below and in refineries like the one at right, C-E boilers use just such fuels to provide dependable, low-cost steam.



The WCC Boiler (see inset) is a Package Boiler of Controlled Circulation design.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

MATERIALS PROVIDE LOW-COST HARNESSED BY C-E



The CO Boiler (see inset) employs tangential firing, producing the tornado-like pattern illustrated in color, to burn catalyst regenerator gas.

As discussed on the opposite page, two interesting examples of waste heat "in harness" are the applications of specially designed C-E boilers to the exhaust of steel mill open hearth furnaces and to the catalyst regenerator exhaust of a refinery. In each case, the gases used are peculiar to the industry involved. In one instance, they are sticky and corrosive and offer only sensible heat. In the other, the gases are toxic and moist, and contain a lean measure of chemical heat in the form of carbon monoxide—in addition to sensible heat. In both cases, C-E advanced engineering has created boiler designs (see sketches) ideally suited to the heat source—boilers which provide maximum steaming capacity with minimum maintenance. Other C-E boiler designs in the waste heat category are in service using a wide variety of waste process gases — with and without chemical heat. In the area of marginal and by-product fuels, C-E has designed and placed in service a large number of boilers which burn such wastes as refinery sludge, wood shavings, sawdust, pith, rice and oat hulls, furfural waste, bagasse, peanut shells, grape skins, spent coffee grounds, black liquor and, of course, coke oven and blast furnace gas.

What all this adds up to is the fact that there is really no such thing as waste heat—there is only *wasted* heat. And there needn't be—because Combustion has the know-how and experience to put almost any potential energy source to work for you—to provide you with an extra dividend in the form of additional low-cost steam for your plant. Why not investigate harnessing a C-E boiler to your waste heat or by-product material? The amount of money it can save for you may be surprising.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N.Y.

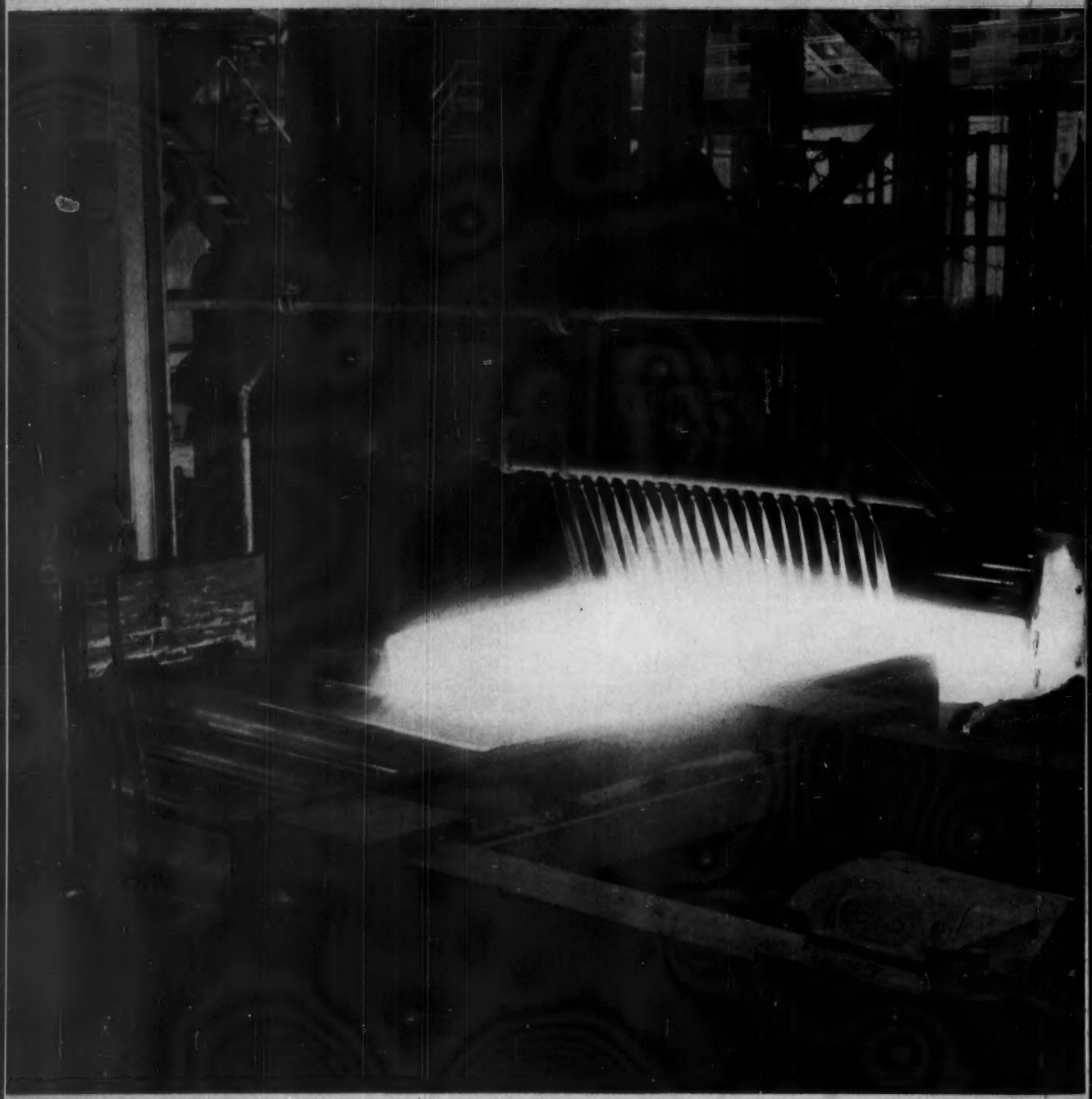
C-227

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more facts circle 228 on Reader Service card, p 99

DE LAVAL
CENTRIFUGAL PUMPS

for high-pressure

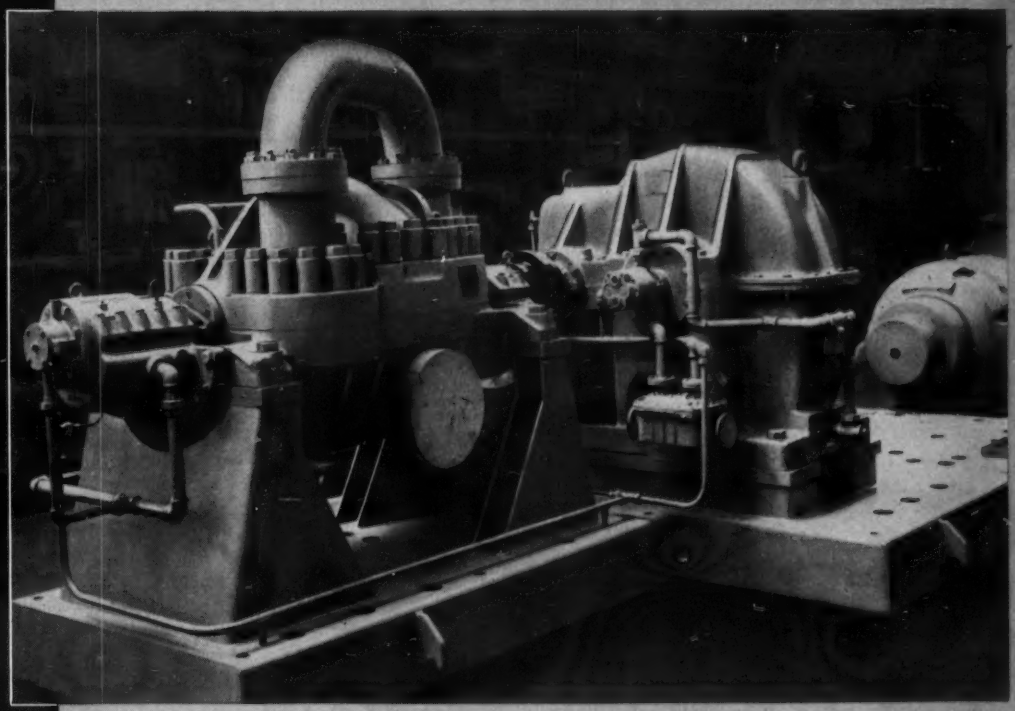


descaling at Lukens Steel

Latest successful technique of high-pressure descaling is now being performed in this modern steelmaking facility designed by Mesta Machine Co.

The initial high-pressure descaling operation uses De Laval split-case multi-stage pumps as shown in the photograph below. Each pump supplies cold water at 1000 gpm and 1600 psig. Electric motors rated at 1750 hp drive the pumps through speed increasers which raise the speed from 1200 rpm to 4250 rpm.

De Laval pumps also serve Lukens on a 1200 psig descaling system in another section of the Coatesville, Pa. mill.



One of several arrangements available for descaling service at pressures of 1000-1200-1600 psig and capacities to 2200 gpm.

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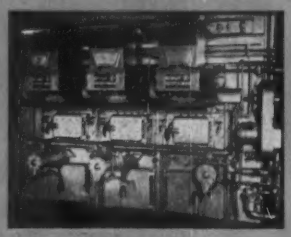
With a Detroit Stoker you can burn coal the modern way . . . saving 10% to 40% over other fuels.

Detroit Stokers are dependable, durable . . . last for decades. There is a type of Detroit Stoker to meet your needs.

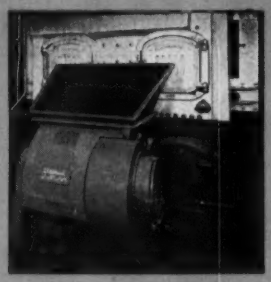
Let us show you the savings available. Recommendations by our engineers will cost you nothing.

DETROIT ROTOSTOKER



Spreader stoker. Economically burns all grades of Bituminous coal or Lignite. Power, hand dumping or stationary grate types.

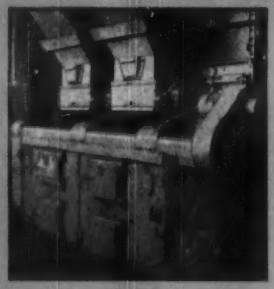
DETROIT LOSTOKER



Compact underfeed stoker for smaller boilers. Capacities 3,000 to 12,000 pounds steam per hour. Plunger feed, mechanically driven side cleaning. Coal feed and air supply may be automatically controlled.

DETROIT ROTOSTOKER—TYPE C-C

(Continuous Cleaning) Reciprocating grates that slowly discharge ash at front. Steaming capacities from approximately 5,000 to 75,000 pounds. Smokeless with wide load range.



DETROIT SINGLE RETORT STOKER (Detroit UniStoker)

Side cleaning, underfeed stokers. Motor or turbine driven. Adjustable feed provides manual and automatic control. Capacity range 12,000 to 24,000 pounds steam per hour.

DETROIT ROTOGRATE STOKER

Spreader stoker for higher capacities up to 400,000 pounds. Forward moving grates that discharge ash at the front. Higher burning rates for longer periods. Heavy duty.

DETROIT DOUBLE RETORT STOKER

Side cleaning heavy duty underfeed stoker with two retorts, mechanically driven. Available for capacities from approximately 20,000 to 34,000 pounds steam per hour. Requires no basement.

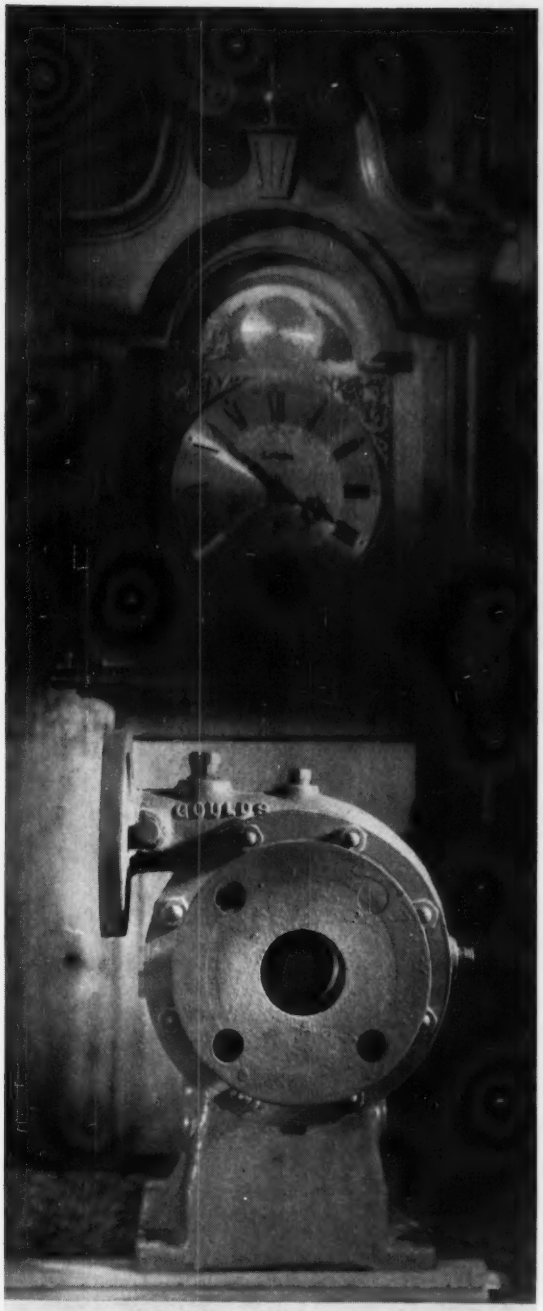
DETROIT STOKER COMPANY

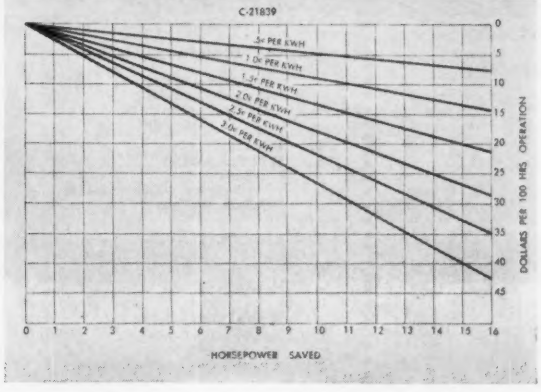
MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

DETROIT SINCE 1898 STOKERS

For more facts circle 230 on Reader Service card, p 99





How do you know when you need a new pump?

"One way is to calculate power saving," writes Phil Olmstead, *Chief Engineer*, Goulds Pumps, Inc.

If your *needs* have changed since you installed your present pump, or . . .

If *efficiency points* have changed due to deposits building up in your piping, or . . .

If your present pump is *frequently under repair*, then . . . it's about time you began thinking about getting a new pump!

That's a pretty good rule of thumb to go by when the time comes to consider replacing an old pump with a new, efficient unit. But you don't have to rely merely on rules of thumb—you can actually *calculate* the power saving a new pump will bring you. Let me illustrate:

Only recently I discussed and demonstrated power saving with an engineer friend of mine. He had a pump that he had purchased five years ago. At that time its efficiency was high . . . but changing conditions led to reduced efficiency. According to the pump curve, its efficiency had dropped to 73 per cent: *600 gallons per minute @ 240 total dynamic head (pressure)*.

To prove a point, we went through the Goulds catalog and found a pump with the same rating but which was 82% efficient.

Next we merely applied the following formula to determine the brake horsepower:

$$\text{BHP} = \frac{\text{Gallons per Min.} \times \text{Total Head in feet}}{3960^* \times \text{Pump efficiency expressed as a decimal}}$$

*Horsepower conversion figure (foot-pounds to gallons per minute)

This is what we got:

$$\text{OLD PUMP:} \quad \frac{600 \times 240}{3960 \times .73} = 49.8$$

$$\text{NEW PUMP:} \quad \frac{600 \times 240}{3960 \times .82} = 44.3$$

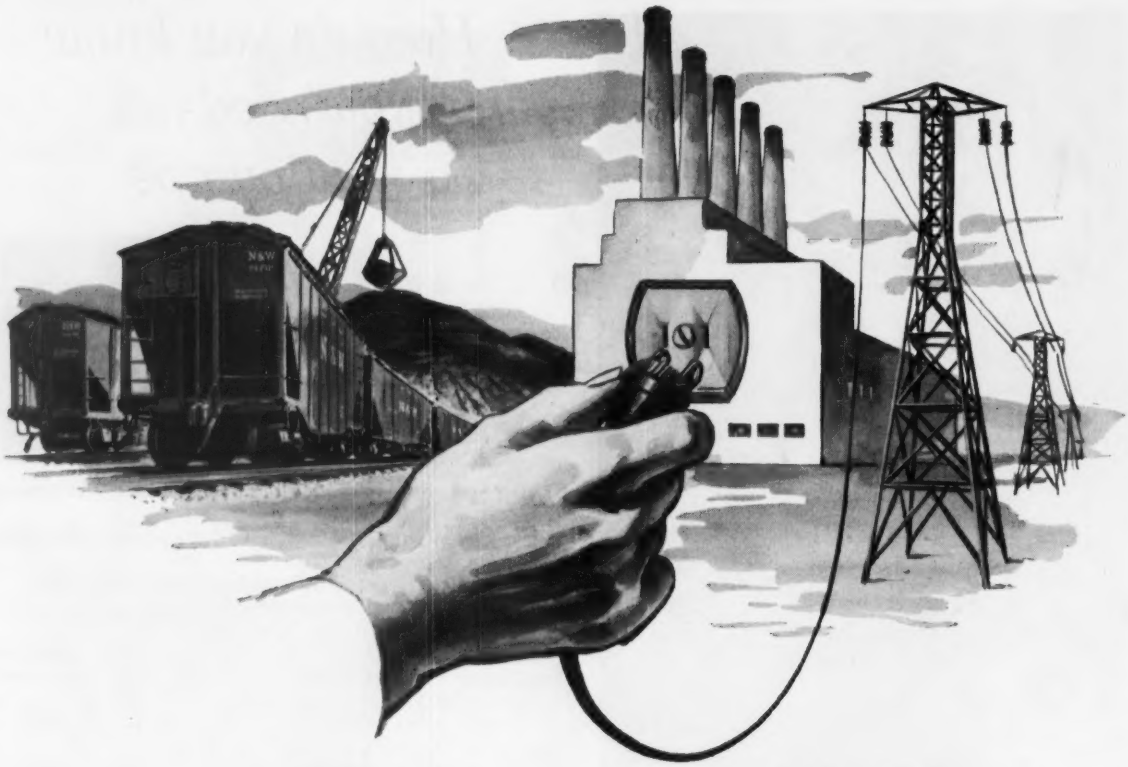
HP SAVED: 5.5

Now check the savings chart illustrated on this page. Follow the "HP saved" line to the electric current rate line—in this case, 2¢ per KWH. The savings per 100 hours of operation would be approximately $10. At, say, 10 hours a day, 300 days per year, my friend saw that he would be saving around $300 with a new pump.

Try it for *your* pump. Calculate how much you would save with a new Goulds pump replacing your old one. Then call in a Goulds application engineer to talk it over and determine the *right* one for your needs. Or drop a line to me, Phil Olmstead, at Goulds Pumps, Inc., c/o Dept. PO-79, Seneca Falls, New York, and I'll see that you get the information you need.

GOULDS PUMPS

For more facts circle 231 on Reader Service card, p 99



Send the finest coal by wire!

When the coal you burn meets your exact requirements, you operate at high efficiency. And high efficiency is a prime factor in reduced costs, higher return on your investment.

That's why outstanding utilities use Fuel Satisfaction, the all-purpose, superior Bituminous coals mined along the lines of the Norfolk and Western. Modern mining and expert preparation methods let you specify the exact coal that meets your requirements.

N&W coal specialists will welcome an opportunity to analyze your needs and see if your operating efficiency can be increased through use of Fuel Satisfaction.

Norfolk and Western

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Roanoke, Virginia

BOSTON
833 Chamber of Commerce Building
Telephone Liberty 2-2229
Boston 10, Massachusetts

CHICAGO
660-664 Marquette Building
140 S. Dearborn Street
Telephone RAndolph 6-4634
Chicago 3, Illinois

CINCINNATI
913 Dixie Terminal Building
Telephone DUnbar 1-1325
Cincinnati 2, Ohio

CLEVELAND
Room 722,
The Illuminating Building
Telephone MAin 1-7960
Cleveland 13, Ohio

DETROIT
1514 Book Building
Telephone
WOodward 1-2340 or 1-2341
Detroit 26, Michigan

ST. LOUIS
2059 Railway Exchange Building
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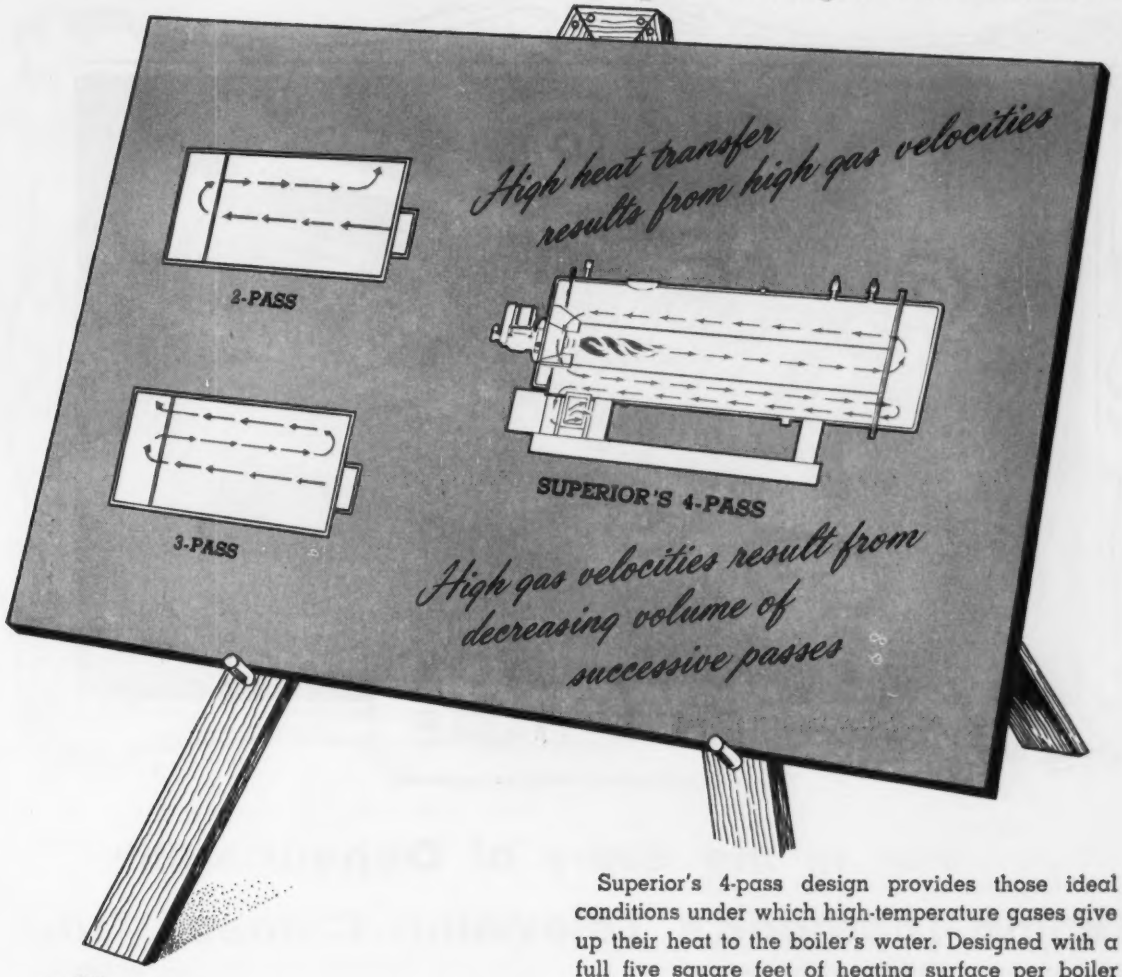
For more facts circle 232 on Reader Service card, p 99

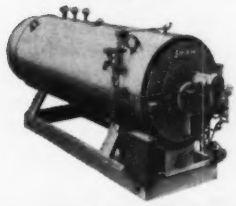
SUPERIOR'S 4-PASS DOWN DRAFT DESIGN

provides higher heat transfer


High heat transfer results from high gas velocities
2-PASS
SUPERIOR'S 4-PASS
3-PASS
High gas velocities result from decreasing volume of successive passes

Superior's 4-pass design provides those ideal conditions under which high-temperature gases give up their heat to the boiler's water. Designed with a full five square feet of heating surface per boiler horsepower, Superior boilers have reducing tube volume in successive passes. This reduced volume crowds the gases into intimate contact with the tube walls producing high velocities, and resulting in a continual scrubbing and cleaning action as the gases pass over the inner tube surfaces.

The down-draft arrangement of the 4-passes promotes the rapid steaming without surging, which results in dry steam . . . and in addition, this down-draft design traps the boiler heat during off periods, preventing its loss up the stack.



SUPERIOR "TYPE CF"
PACKAGED BOILERS

Completely packaged fire-tube units for capacities from 20 to 350 bhp. Rotary burners on all sizes. Induced draft for clean, quiet safe operation. Fully insulated and ready for service burning oil, gas or both in combination. Pressures to 250 psi, or for hot water operation. Other fire-tube models for capacities to 600 bhp. Write today for Bulletin 11CF.

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SUPERIOR
PACKAGED BOILERS

For more facts circle 233 on Reader Service card, p 99

84,000 Hours of Reliable Viewing

. . . that is the Story of Dependability Behind Diamond's Television Camera Tube

Nor is the Story Finished. The ORIGINAL TUBE, installed in 1949, is Still in DAILY OPERATION!

At the Wood River Station of the Illinois Power Company, Diamond's "Utiliscope" Television system has provided 100% available viewing since 1949. In this job, dependability is all important! Only Diamond builds the tube which makes this availability possible.

The operator, in the control room, sees the boiler water level at the drum by viewing the Diamond monitor mounted in the control panel. Water level information is instantly and accurately available at all times from any viewing position in the control room.

Routine maintenance is the only service required since installation. "Old Reliable" has a record of more than ten years of operation and is continuing to provide reliable service.

Such performance is not unusual for Diamond's "Utiliscope" equipment. This Heavy Duty Television is designed for industry. It is dependable, durable, resistant to time and difficult operating conditions. It is saving money and improving operation in power plants, steel mills, foundries, mines and a wide variety of manufacturing plants.

Write us for a non-obligating survey of your plant by our industrial television specialists. Electronics Division, Diamond Power Specialty Corporation, Lancaster, Ohio.

8310

Diamond

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO *Diamond Specialty Limited, Windsor, Ontario*

For more facts circle 234 on Reader Service card, p 99

LOUIS N ROWLEY, EDITOR • JULY 1959 • ESTABLISHED 1882 Power

Coal powers America's progress

That's the title of a special advertising supplement that appeared in the *New York Times* of Sunday, June 7. Sponsored by the National Coal Association, it was designed to "show the part coal plays in the life of the United States . . . tell the story of the startling changes that have swept over this essential industry. . . ."

You will be interested, as I was, in some facts brought out in the several articles comprising the supplement. Here are a few highlights:

We have all heard of mechanization in the mines —new cutting machines, power drills, mechanical loaders and the continuous miners that chew into a coal face, tear the coal loose and pass it back to conveying equipment. In the strip mines, the largest mobile land machines rip off overburden at unprecedented rates. These modern mining machines are interesting in themselves, but the real interest attaches to the results.

In 1946, the average coal miner produced 6.3 tons per day. Mechanization boosted the 1958 daily average to 11.3 tons. These strides in productivity have held the average value of coal at the mine practically constant over the past decade, despite wage increases that have added up to $8.20 per man per day in the same period.

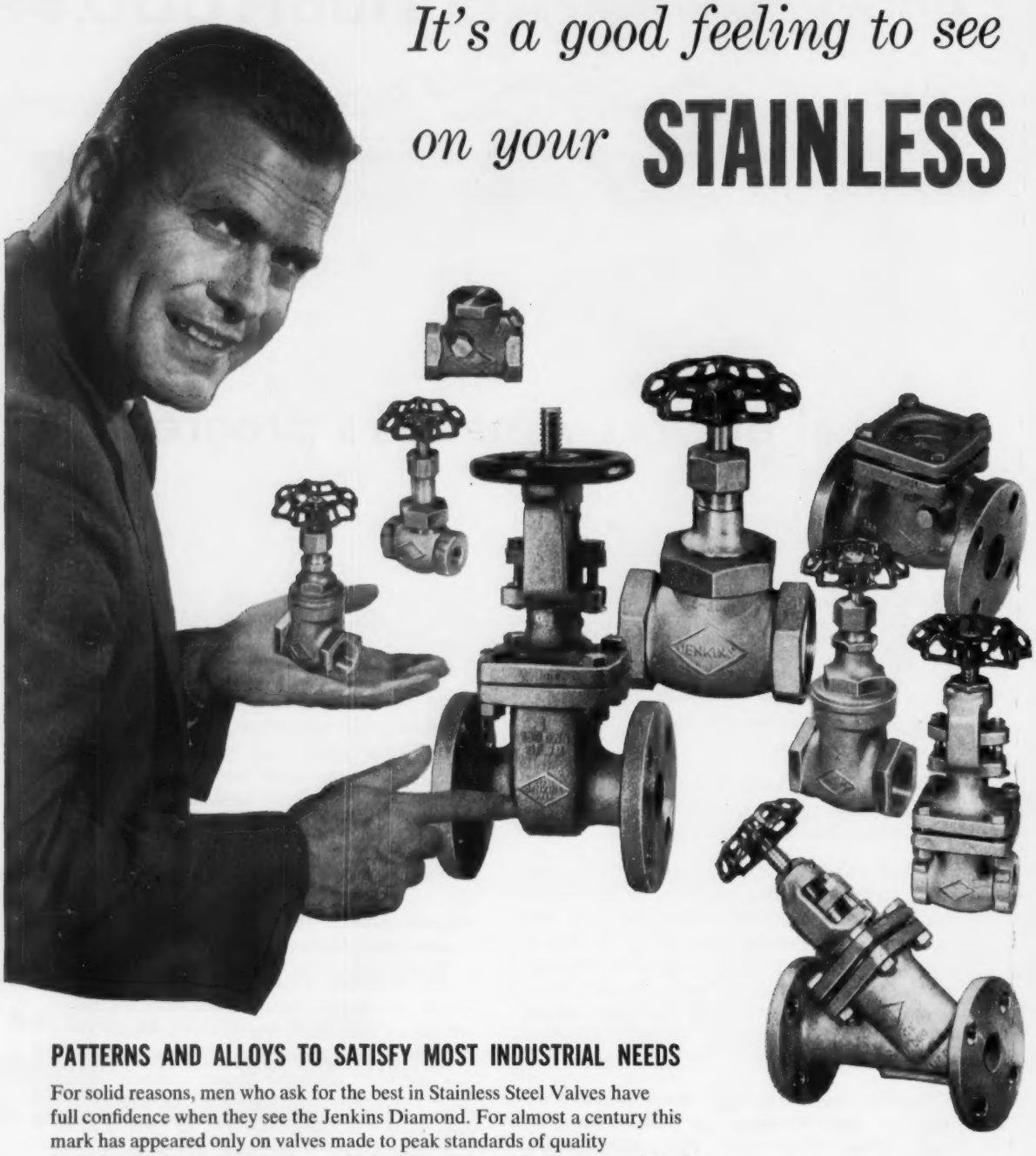
Mining is, of course, just the beginning. The past ten years have seen great advances in "preparation"—the often automated facilities that clean, crush and size coal to meet customer specifications. And the industry looks hopefully at transportation advances that promise to reduce the cost of delivering coal to its users.

The 108-mile pipeline from Cadiz, Ohio, to a Cleveland generating station has focused attention on this relatively new way of moving coal. For the increasing waterborne traffic improved equipment is being developed, including the first self-discharging "super" collier, capable of hauling 24,000 tons per load. Finally, for the more than three-quarters of coal production that moves by rail, cooperation between leading producers and railroads promises special rates for bulk tonnage to reduce transportation cost.

These evidences of the coal industry's determination to become an ever more-efficient producer of raw energy have direct and vital concern for all of us in the power-service field. Electric utilities are now the coal industry's largest customer group, using 153 million tons last year The utilities estimate this will rise more than 50% by 1965 (POWER, May 1959, p 59). If we add to this the millions of tons used by industry for power production, space heating and process, we can see sharply the importance of coal in our energy picture. And we can see how reassuring it is to know that the coal industry is keenly aware of its product's importance to the U.S. economy and is working to discharge this responsibility with ever-increasing effectiveness.

It's a good feeling to see

on your **STAINLESS**



PATTERNS AND ALLOYS TO SATISFY MOST INDUSTRIAL NEEDS

For solid reasons, men who ask for the best in Stainless Steel Valves have full confidence when they see the Jenkins Diamond. For almost a century this mark has appeared only on valves made to peak standards of quality in design . . . in castings . . . in machining. JENKINS standards, enforced by the most rigid inspection and testing in the valve industry.

Valves of corrosion resistant stainless steels have been made to those high standards by Jenkins for a quarter of a century. And today, the line of Jenkins Stainless Steel valves includes types and alloys to fully satisfy most service requirements.

They are available through the same leading distributors everywhere who sell Jenkins Valves of Bronze, Iron and Cast Steel.

JENKINS VALVES JENKINS SINCE 1864

this trusted mark

STEEL VALVES *too*

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☐ Send the new stainless steel valve catalog

☐ Have a representative call on me

NAME & TITLE.....

COMPANY.....

ADDRESS.....

For more facts circle 235 on Reader Service card, p 99

Circle 236 on Reader Service card for Following Ad ➤

Above: After welding together two sections of volute (one shown below) the areas adjacent to the welds are high frequency induction heated to 1950°F. prior to quenching.

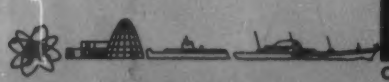
Below: Section of volute which is fabricated entirely of Stainless Steel Type 316, for handling of liquid metal at 1250°F.

Stainless Steel Volute for liquid metal...

fabricated by Pittsburgh Piping

This stainless steel volute was fabricated by Pittsburgh Piping for a leading builder of nuclear energy equipment. The job was awarded to us because we have highly specialized facilities, plus broad experience in nucleonic piping work. This experience began when we fabricated piping for the Nautilus and for the main coolant lines of the Shippingport atomic-powered central station. It has been extended and expanded through the work we have been doing for the atomic-powered submarine and surface vessels now being built, and for scores of government and industrial nuclear energy installations. Use this experience on your next nucleonic piping job. Our representative will call on request, or we will be glad to have you visit our plant.

PIONEER FABRICATOR OF HIGH PRESSURE PIPING FOR NUCLEONICS



Pittsburgh Piping AND EQUIPMENT COMPANY
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Atlanta....Whitehead Building Cleveland...Public Square Building New York..Woolworth Building
Chicago..Peoples Gas Building New Orleans.....P. O. Box 74

PP-38

Design and equipment application section

B G A SKROTZKI
Associate Editor in Charge

SAFETY SYSTEM brings to operator instant, complete identification of the trouble

The expanding field of safety monitoring

- New monitor designs show increased dependability
- Improved explosion-prevention equipment is coming soon
- Use of computers for large systems can save money

By L E STEWART
Assistant Editor

Plant safety has become a major engineering goal in the last decade as power services grow in capacity, complexity and investment to be protected. The equipment above, common in large utility plants for years, is now an increasingly important part of industrial power and plant services. Spread-out or even isolated equipment demands continuous, on-the-spot safety monitoring. This is increasingly accomplished by safety switches, controls and monitors at equipment location combined with

special warning and identification units plus recording instruments in central control panels.

In this report POWER outlines current practice, recent trends and some needs of future safety systems. Since overall field of safety monitors is so broad we exclude equipment for electrical systems in order to do a better job on the growing mechanical area.

To begin, let's look at monitors for basic temperature, pressure, flow measurement.

Temperature monitors are basic to safety systems

System temperatures, high or low, find importance as direct or indirect measurements of operating safety. In larger power-services systems, some temperature monitors take the form of warning or control run-back devices. In smaller installations where unattended operation predominates, separate temperature trips or interlocks are major control items.

For large systems most monitors take the form of auxiliary contacts on temperature indicators or recorders. New developments in differential-expansion tube thermometers show promise where a small number of high temperatures, 500 F and up, need monitoring.

Monitors for 0- to 500-F range employ vapor- or gas-pressure bulbs, differential-expansion tubes and some thermocouples. Expanding use of thermistors for fixed-set-point temperature cutoff stems from tamper-proof characteristics plus use of fail-safe circuit design in the control package.

Low-temperature cutout is important as part of systems like packaged-boiler control, where low temperature for residual fuel oil represents a dangerous combustion instability.

At even lower temperatures, air conditioning and refrigeration systems require protection against coolant freezing. In this range gas- and vapor-pressure bulbs predominate and differential-expansion tubes or thermistors are just beginning to catch on. Future growth of power services using sub-zero temperatures can be expected to push development of new temperature-switching mechanisms and techniques. Progress here will spill over into higher temperature ranges within ten years.

New pressure monitors boost system safety

Pressure safety falls in a different category. For instance, pressure-vessel codes require mechanical pressure-relief mechanisms. Overpressure trips then become a secondary safety item designed to protect ultimate pressure-relief elements. Packaged-boiler high-pressure cutouts, pump and compressor high-pressure cutouts are examples of this type of equipment.

A second pressure-trip use involves pressure measurement as a monitor of a related hazard. Refrigeration or air-conditioning systems often monitor refrigerant pressure as a warning against too low temperatures. Low-fuel pressure for gas- or oil-fired units usually interlocks at least with lightoff control. Pressure differential across gas-recirculation fans compared to boiler differential signals danger of reverse flow and fan overheating.

Majority of pressure switches in use are simple, rugged and inexpensive. Current trend ties mechanical measurements to electrical switching. Since many uses of switches involve secondary safety precautions, signals from pneumatic or hydraulic transmitters can actuate a pressure trip. In this application, pressure switches often monitor pressures, flows, temperatures and control drive positions. Expanded use hinges on increased dependability of transmitters.

Flow monitors expand fundamental equipment-safety field

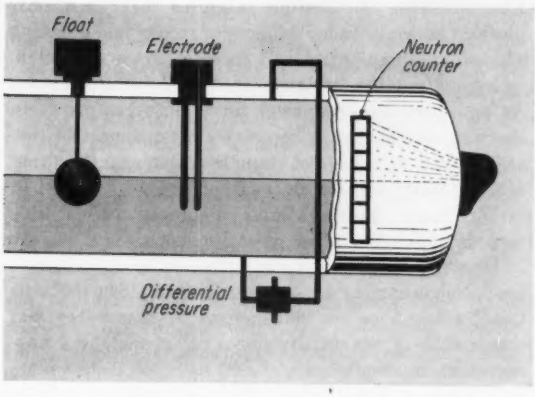
Flow switches usually anticipate related unsafe conditions such as low bearing lube-oil flow, low atomizing-steam flow for oil burners, low combustion-air flow. In cooling cycles where refrigerant temperature runs below coolant's freezing point, a coolant-flow stoppage while refrigerant cycle is running would rupture tubing. Low-coolant-flow switches prevent operation of refrigerant cycle under these conditions.

Flow switches generally fall in two categories: (1) obstruction switches actuated by kinetic force, which place paddles, turbines, etc in flow path (2) d-p (differential-pressure) switches operated by pressure drop across some fixed resistance. In recent years compact, rugged and highly dependable flow switches have increased flow sensing as a safety trip. Fail-safe circuit design now spots switch jamming or breakdown, and over-pressure protection for d-p cells cuts component failure to the bone.

Although d-p cells are equally available for electrical or pneumatic and hydraulic output, current use favors electric models.

Future growth of d-p flow sensing depends upon improved measuring techniques. Attention to design points such as placement of orifices will greatly improve sensitivity and dependability of flow switches.

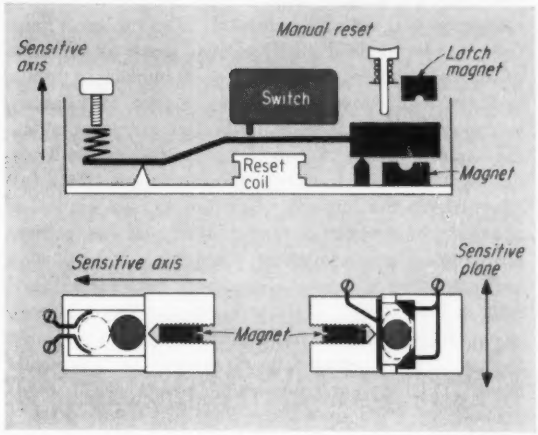
Liquid-level monitors strive for even greater reliability



Level monitors operate in area of prime concern for boilers, fired pressure vessels. Low-water level was always one of most dangerous conditions, and expanded use of unattended packaged steam generators makes problem acute. Low-level monitors act as warning devices on larger units, fuel trips on unattended or smaller units.

Drawing, left, shows basic types in use on pressure vessels. Basic float switch handled job for years. With new fail-safe circuitry, switch still fills needs of many units. Electrode probe solved problem of moving parts, shares packaged-boiler field with float. D-p unit shows up again as level monitor; operating as indicator, warning switch for larger, higher-pressure systems. Neutron counter places source and counter outside shell of vessel: beam activates all counter blocks above liquid level. Present use covers only thin-walled vessels.

Vibration trips find more uses in power services



Vibration switches become major plant-safety components as more high-speed pumps, turbine drives, blowers enter service. Industrial-turbine supervisory systems include vibration trips in majority of cases. Utilities and, to an increasing degree, industrial plants use vibration monitors as trips for all important units. No warning here! Danger is too great, elapsed time too important to depend on human intervention.

Vibration switches at left are seismic masses actuated by acceleration. Mass-spring unit, top, is sensitive to vibration in one axis. Acceleration switch, below, uses magnetic force to hold ball. Slight change in basic design modifies sensitivity to handle vibration in a plane. Unit can be designed for axial, plane, or omnidirectional sensitivity, normally open or closed contacts.

Present trend to vibration monitors is beginning of what may be greatest safety-equipment expansion.

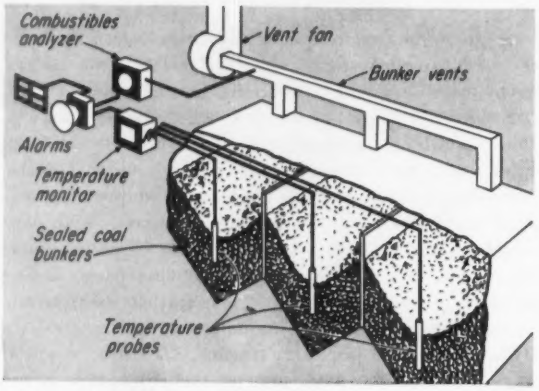
Nuclear-plant safety hinges on neutron counters

Nuclear instrumentation differs from conventional systems in two ways: (1) Primary variable is neutron density in reactor, compared with fuel-firing rate in conventional boilers. This introduces the neutron-flux meter as a major operating instrument. (2) Normal recording, controlling instruments also function as safety monitors. The dependability implied in this statement is typical of nuclear-plant requirements.

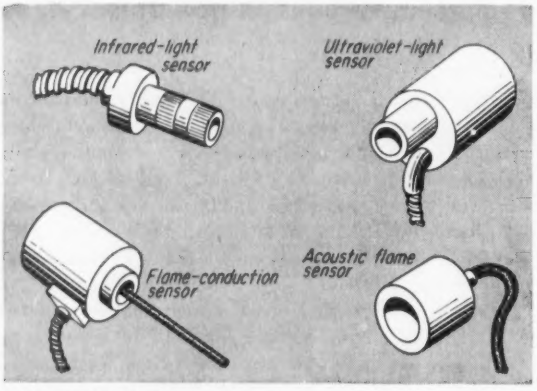
Neutron-flux meters supply safety system with measurements of reactor power level and reactor period (time required for power to change by factor of 2.718). Conventional safety trips operate from cycle temperatures, pressures and flows. In many cases measurements are taken in triplicate and fed to "auctioneering" equipment which selects one value for control.

Safety trips operate on "degree-of-danger" principle. High power level or short reactor period starts a fast but orderly shutdown of reactor and plant. If power level goes higher or reactor period shortens further safety trips actuate SCRAM control system. **continued**

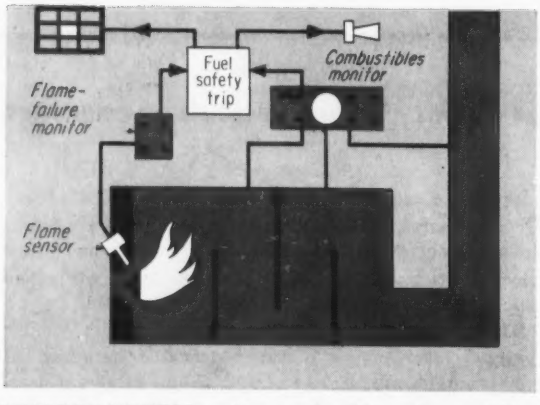
Explosion prevention gets high priority in development of



BUNKER MONITOR constantly checks for hopper fires with probes. Combustibles analyzer spots explosive mixture in bunker vent line



FLAME MONITORS sense special properties of combustion by checking gas ionization, light emission or flame-noise frequency



EXPLOSION MONITOR combines combustibles analyzer and flame sensor to signal loss of fire or gas buildup in the boiler passes

Explosion danger is present with many power services, wherever combustible mixtures may exist. Explosion areas include: boiler furnaces, fuel-handling and -storage equipment and enclosed areas around it, hydrogen cooling systems, some refrigerant cycles. As power-service equipment for these areas grows in size and complexity, it becomes almost impossible for an operator to react fast enough to danger. Resulting accident costs and rising insurance rates force use of furnace-flame monitors and elaborate combustible sensors with other types of equipment.

Bunker explosions and accidents to related fuel-handling equipment have shaken several modern plants. Coal-bunker fires are bad enough by themselves, but combustible gases usually given off at the same time represent an even greater hazard. Some coals create an explosion threat when they are crushed or even disturbed in the pile because of methane-gas release. Gas lies in pockets in coal, escapes from newly exposed surface. Research indicates liberated gas may be one or more times volume of coal and varies directly as the surface area of coal. Methane collects under hopper roof where it can be ignited by static charges generated by conveyor belts, etc. Warm or hot coal accelerates release of gas, and if fire is present carbon monoxide will also be generated. The explosive mixture may be touched off by electric spark or exposure of glowing embers as coal moves in bunker.

Many explosions cause little damage to bunkers, probably because there's insufficient air to complete the explosive effect. Incompletely burned gases driven out by the initial bunker explosion release their full effect above the bunkers. In addition, gas explosion above the bunker can disturb a lot of coal dust present on the floors and equipment, amplifying the explosion and extending it into coal-conveyor enclosures. Coal dust in itself is not likely to create explosion hazard, as concentration in the order of fifteen grains per cubic foot is required, depending on fineness, to propagate flame. This concentration would be too dense to see through for a distance of one foot.

Safety monitoring usually includes temperature probes in the bunkers to signal combustion. Latest proposed refinement adds combustibles analyzer connected to forced ventilating system. Combustibles sensor gives a good indication of explosive gases and early stages of bunker fires. Monitors are straight warning devices, so responsibility for accident prevention still rests with operators. Plant safety depends on a clean plant, design of adequate venting systems and a good warning system to assist operator. For hydrogen or other explosive gas systems, venting coupled with gas analyzer appears to be the trend.

Furnace explosion protection breaks down into categories according to complexity of system monitored. Single-burner packaged boilers use flame rod or optical sensors, left, as flame-failure monitor. Burner-flame monitoring assumes that the presence of flame means safe operation. When flame sensing is

new safety-monitor systems

included as part of an automatic control and safety system this is a reasonable assumption.

Flame rod or flame-conductance sensor does an excellent job for gas-fired burners, is sensitive to poor combustion. However, when applied to oil firing, flame rod may increase maintenance and nuisance shutdowns.

Photoelectric cells answer the need for a nonfouling sensor for oil firing. Units mounted outside the combustion chamber monitor flame through sight tubes in the burner throat or furnace walls.

Cells use photo-conductive or photo-emissive elements sensitive to light in various spectrum ranges, one cell falling in the ultraviolet range and several others in the infrared range. To date, infrared-sensitive cells predominate in the oil-fired boiler field. Since these cells are sensitive to any form of infrared light, safety control circuit must respond only to pulsating light of burner flames. In some cases ratio of infrared emission for oil and gas flame caused sensor difficulties: a cell sensitive enough to monitor gas was blinded by oil flame. Ultraviolet sensor was developed to handle multi-fuel burners. Coal, oil and gas all emit enough ultraviolet light to operate flame-failure systems, and ratio of emission doesn't create blinding.

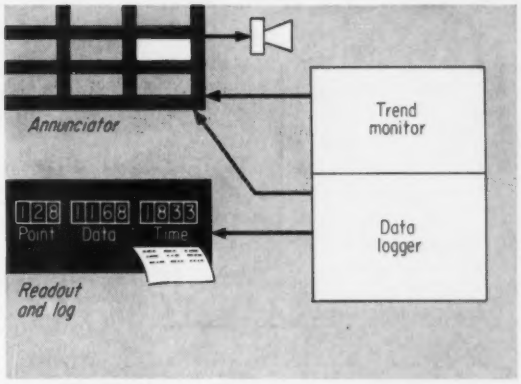
All photoelectric cells require special placement on multi-burner units to prevent flame from one burner triggering cell for adjacent burner.

Acoustic flame monitor presents alternate scheme dependent on characteristic noise frequency of flame. Still under development in this country, unit has successfully monitored oil- and gas-fired units overseas. Big advantage of acoustic unit lies in its ability to monitor flame without direct line of sight. With multi-burner units, curved pipes running from burner throats to outside microphone mountings could prevent signal interference between adjacent units.

Explosion monitor for large, multi-burner units may follow scheme suggested at 1958 ASME Annual Meeting in New York. Drawing, left, shows a combined flame-failure-combustibles monitor system designed to spot dangerous operating conditions as early as possible. Use of flame-failure sensors alone for multi-burner furnaces poses some major problems. How many burners can be allowed to black out before you trip the unit? Also, blackout may follow long periods of firing with insufficient air. After blackout, oxygen can build up rapidly to explosive mixture.

Combustibles monitors do not give complete protection either. Time lag involved in gas analyzing may be too great to prevent explosion. During startup, furnace temperatures are not high enough to crack solid coal particles or residual fuel oil into non-condensible gases, so analyzer can't spot buildup.

Combined monitor seems to show greatest promise for large units. Flame sensors would monitor burner and lighter flames while gas analyzer would check dangerous buildup of combustibles and signal sudden increase in oxygen. Total fuel trip would operate when both types of monitor agreed on danger of explosion.



CENTRAL ALARM CONTROL feeds operator of major power service with instant warning, identification, data for action.

Centralized safety pays off for expanded plant services

We have described various areas of plant safety in preceding sections. Now, let's take a look at the entire safety system. In most modern power-services systems some degree of control centralization exists. Along with centralized controls operator must have all information he needs for safe, efficient running of the entire system. Although conventional safety trips can be located throughout the plant, complete information and warnings must be available to the operator before he can take corrective action.

The first requirement for centralized safety is adequate warning of danger and positive identification of danger area by some kind of annunciator panel. Standard equipment in large power plants for years, annunciator panels are finally beginning to show up as regular components of other power-services control.

For larger control systems time-sharing of some safety-monitor equipment helps justify cost of more sophisticated data-logging and trend-tracing units. High-speed printers, trend logs and computer control can be justified on the basis of potential cost of even one major accident. As single-generator capacity soars toward the million-kw mark, estimates of average cost of an accident run to $500,000, excluding downtime penalties. This money would buy a lot of safety.

For a more complete story of data loggers and computer control see POWER's January 1958 *TD* on computers, August 1958 story of Sterlington data logger, May 1959 report of Little Gypsy's computer control.

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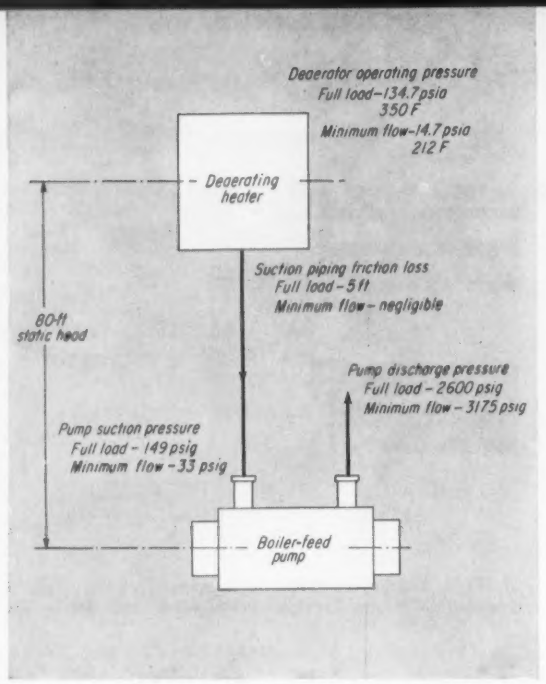
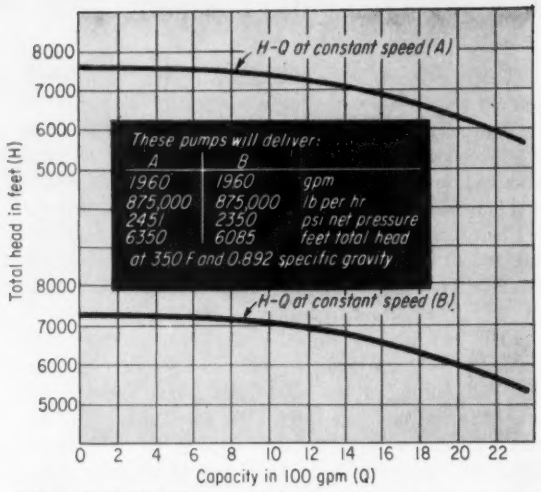


OPEN CYCLE has deaerating heater mounted above boiler-feed pump. Controls maintain deaerator pressure above atmospheric



HEAD CAPACITY CURVE (*A*) holds for boiler-feed pump used in open cycle. Curve (*B*) is good for boiler-feed pump in closed cycle

Are you an optimist or pessimist when . . .

Selecting pressure rating for closed feedwater heaters?

Part I of this 2-part report explains how these divergent viewpoints affect heater cost

By I J KARASSIK*
Worthington Corporation

A recent editorial commented on the complete lack of a trend in driving arrangements used for high-pressure boiler-feed pumps. Let me add that many other factors connected with selection and application of boiler-feed equipment also exhibit differences in designer thinking. A partial list of decisions the designer has to make includes: (1) Feedwater cycle: open or closed? (2) Number of pumps: two half-capacity or one to handle full capacity? (3) Spare pumps: yes or no? (4) Operating speed: conventional 3600 rpm or high speed? (5) Drive: electric motor, steam turbine or main turbine shaft? (6) Feedwater control: feedwater regulator with constant- or variable-speed pump or a variable-speed pump with no regulator? (7) Feedwater regulator location: downstream of all closed heaters or right after the feed pumps? (8) Pressure rating of closed heaters: absolute maximum possible pump discharge pressure or the probable maximum?

Older power plants involved much lower pressures than we encounter today. Heater pressure rating was not as critical and variations in thinking seldom made significant differences in selection. Heaters were designed to handle maximum pressure possible under any circumstances. Usually this resulted in the same standard rating that a more optimistic approach would dictate.

But at today's higher level of operating pressure this is no longer true. Choice between a pessimistic and an optimistic approach does affect cost of feedwater heaters. Much emphasis has been placed on an all-out effort to reduce the dollars invested per kilowatt. So it is reasonable for designers to thoroughly analyze the many factors involved in selecting closed heater pressure ratings.

First step is to establish our criterion of a pessimistic and an optimistic approach. The boiler-feed pump may operate anywhere in its capacity range from maximum flow to the minimum needed for protec-

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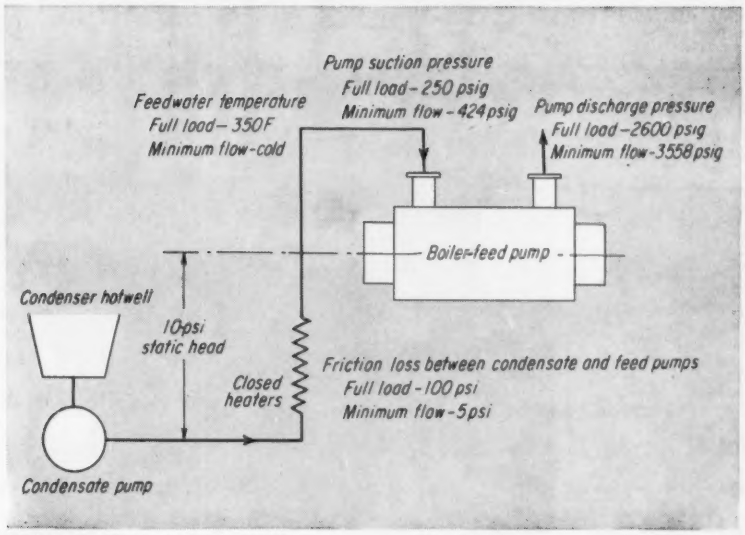


CLOSED CYCLE includes the condensate pump and boiler-feed pump operating in series. Closed feedwater heaters are located between these pumps and on the feed-pump discharge

tion against overheating. Maximum head will equal shutoff head at rated speed. Feedwater can be handled at any temperature from cold up to that at full load conditions. Pump pressure in psi varies inversely with specific gravity. So maximum pressure at rated speed equals shutoff head, psi with specific gravity of one.

Pessimist assumes that closed heaters must be designed for maximum pump discharge pressure on cold water at full speed. He does not take advantage of feedwater regulator location or the fact that the pump may operate at variable speed.

Optimist makes a number of favorable assumptions. He assumes cold water is handled only on rare occasions. If a constant speed pump is immediately followed by a feedwater regulator, an optimist trusts the regulator to kill excess pressure at reduced load. Using a variable-speed drive, with or without feedwater regulator, he has faith in the control mechanism to hold speed down to correct levels. Again this keeps maximum discharge pressure from exceeding that at full load.

Obviously, there are varying degrees of optimism and pessimism. Compromises are frequently the result of finding that the "first look" decision gives a marginal choice of rating. Boiler-feed pump application also has a major effect on the final decision. Feedwater cycle, feedwater control and location of feedwater regulator all enter into the problem.

First examine effect of the cycle. Maximum pressure will vary depending on whether an open or closed cycle is used. For example, consider a system with two boiler-feed pumps. Each is designed for 875,000 lb per hr of 350-F feedwater (specific gravity = 0.892) against 2600-psig discharge. Design capacity corrected for specific gravity is then 1960 gpm.

Open cycle. Heater pressure at full load, facing page, is 134.7 psia or 120 psig. With 80 ft submergence and suction-piping friction losses of 5 ft, suction pressure at full load is 149 psig. So pump must be designed for 2451 psi net or 6350 ft at specific gravity for 350 F.

Head capacity curve (*A*), facing page, gives 7560 ft total head at a minimum permissible flow of about 400 to 500 gpm. At such light flows suction-piping friction is negligible. Discharge pressure with cold water is then 7560 plus 80 divided by 2.31, or 3307 psig.

Of course we have the right to a nod at optimism: we can assume controls keep deaerator pressure above atmospheric. So feedwater temperature never falls below 212 F and specific gravity will not rise above 0.96. Maximum discharge pressure is then 3175 psig instead of 3307 psig. The advantage is slight, but may make a difference in some cases.

Closed cycle is shown in sketch, *left*. Several heaters are located between the two pumps in series. But the number of heaters in the feed-pump discharge line is the same as for the open feedwater cycle.

When selecting suction pressure a greater margin is generally provided over vapor pressure than is practical for an open cycle. But maximum boiler-feed-pump pressure is not materially affected by a choice in the range of 150 to 250 psig at full load. With 250-psig suction pressure the net pressure is 2350 psi or 6085 ft (corrected for specific gravity at 350 F). Head capacity curve (*B*) shows that pump develops 7340 ft (3134 psig) at minimum flow on cold water.

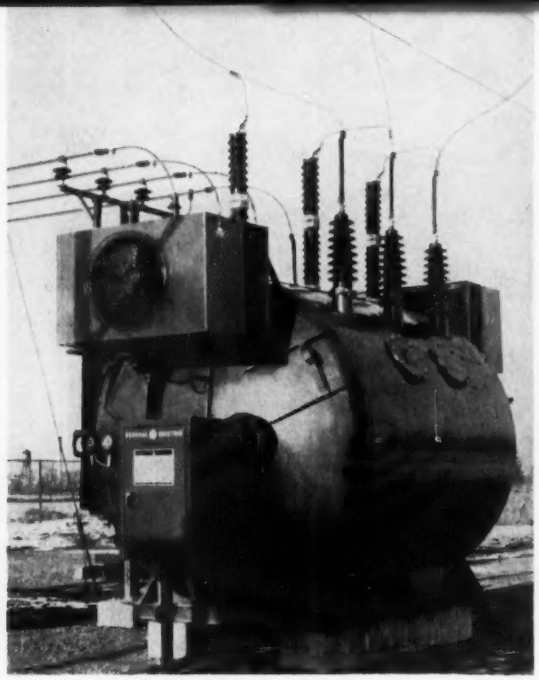
Now estimate performance of condensate pump to determine discharge pressure. Assume a full load suction loss of 100 psi between the condensate and feed pumps. Also assume a static elevation difference equivalent to 10 psi. With another 15 psi of vacuum to overcome, full load net pressure of condensate pump equals (250 + 100 + 10 + 15) or 375 psi. This is equivalent to 870 ft total head.

Total head for condensate pump at minimum flow is about 1050 ft for a net pressure of 454 psi. Friction losses are reduced to about 5 psi. But the 15-psi vacuum and 10-psi static pressure are still there. Suction pressure at boiler-feed pump has increased from 250 psig to 424 psig. Discharge pressure of boiler-feed pump in closed cycle is then 3134 plus 424 or a total of 3558 psig.

Choice between an open and a closed feedwater cycle has a most significant effect on maximum possible pressure imposed on feedwater heaters. It is about 3175 psig for the open cycle or 22% greater than rated pump discharge pressure of 2600 psig. But maximum pressure in the closed cycle is 3558 psig or 37% over same pump discharge pressure.

Second part of this study in an upcoming issue will further examine the effect of optimism and pessimism on heater cost. We'll present results of a survey of public-utilities and power-plant consulting engineers, disclosing the degree of optimism current among designers.

By G CAMILLI
General Electric Co



SULFUR HEXAFLUORIDE is insulating gas utilized in 10,000-kva 69-kv power transformer now in operation at Allentown, Pa.

Search for better fire-resistant transformer insulating fluids begins to pay off with operation of a 10,000-kva unit, as . . .

Gaseous insulation goes to work

The most common gas—atmospheric air—was the insulating medium commonly used in low-voltage equipment in the early years. As the operating voltages were increased, transformer oil was substituted for air. There is no question that oil as an insulating and cooling medium made possible the development of modern transformers. Yet, oil has two objectionable characteristics: (1) It burns when exposed to flame or heated to its ignition point in the presence of air. (2) Certain mixtures of oil vapor and air explode on ignition when confined.

Considering the large number of oil-filled transformers that have given satisfactory service, and the relatively few fires, the use of oil is well justified. Because of possible fire hazard, however, fire underwriters prohibit oil-immersed transformers in certain locations unless they are installed in expensive fireproof vaults. For this reason, dry type transformers were developed for use in congested districts of large cities. When, in 1932, askarel was introduced, transformers were built utilizing this synthetic liquid. Askarel has all the characteristics of oil but is fire resistant.

Askarel in common with oil, however, has still an undesirable feature. When an internal arc occurs, considerable pressure may be developed as the liquids decompose. In some instances this pressure can rupture the tank's seams. Substituting gas for the liquid eliminates this disadvantage. Should a failure occur, the pressure would be a fraction of that developed in a liquid transformer.

Other advantages are gained in the use of gases instead of liquids. Having only a small fraction of the weight of oil, gas results in much lighter transformers; reductions in the order of 20 to 30% are possible in some cases. Since gas is a much poorer conductor of sound than oil, its use results in a transformer with better noise characteristics. An item of major expense in many generating stations is the long isolated-phase bus run usually required between the generator and transformer. In addition to first cost, this bus means costly power losses. Because customary oil-filled transformers must be installed outdoors and often at a distance from the generator building, very little can be done to reduce this expense. Use of gas, however, presents the attractive possibility of locating the transformer flush against the outside wall of the building, or even inside the building eliminating most, if not all, of the bus run. Another and obvious use of gas-insulated units is in the indoor or underground installations and as substation transformers located in congested areas. Here advantages of gas are considerable.

Gas-insulated transformers offer sufficient advantages to offset a somewhat higher first cost. Some day, when volume production, field experience and know-how are increased, there may be no reason why gas-insulated units will not be practical for any power transformer application. As an example, photo above shows a 10,000-kva 69-kilovolt gas-filled power transformer recently built and now in operation on the system of the Pennsylvania Pow-

Physical properties and breakdown voltages of insulating gases

Name of compound	Molecular formula	Molecular weight	Liquid density	Refractive index	Boiling point C	Vapor pressure, 25 C mm Hg	Relative 60 cycle breakdown at 30 cm Hg
Nitrogen	N_2	28	0.808 (–196 C)		–196	Gaseous	1
Perfluoromethane	CF_4	88	1.96 (—184 C) Gas 0.60		–128	Gaseous	1.25
Perfluoropropane	C_3F_8	188	1.45 (20 C) Gas 0.61		–38	Gaseous	2.0
Sulfur-hexafluoride	SF_6	146	1.91 (20 C)		–63.8	Gaseous	2.5
Perfluoroheptane	C_7F_{16}	388	1.733 (20 C)	1.2618 (20 C)	82	110	5.5
Perfluorotriethylamine	NC_6F_{15}	371	1.749 (20 C)	1.262 (25 C)	71	130	6.0
Perfluromethylcyclohexane	C_7F_{14}	350	1.7994 (20 C)	1.2815 (20 C)	76	110	6.0
Perfluorotoluene	C_7F_8	236	1.660 (20 C)	1.3664 (20 C)	102	23	7.0
Perfluorodibutyl ether	$C_8F_{18}O$	454	1.717 (25 C)	1.26 (20 C)	100	33	7.5
Perfluorotri-n-butylamine	$NC_{12}F_{27}$	671	1.88 (20 C)	1.29 (25 C)	178	2.7	8.0
Perfluorodimethylcyclohexane	C_8F_{16}	400	1.8503 (20 C)	1.2896 (20 C)	101	40	8.5
Perfluorophenanthrane	$C_{14}F_{24}$	624	2.019 (20 C)	1.3315 (20 C)	205	—	10.0

er and Light Company at Allentown, Pennsylvania.

Effectiveness of various gases for interrupting arcs has been studied, and circuit breakers are now being built containing sulphur hexafluoride. It's claimed that in a plain-break interrupter, about 100 times as much current can be extinguished in SF_6 gas as in air. When the SF_6 is blown through the arc, even at low velocities, effectiveness of interruption is further increased.

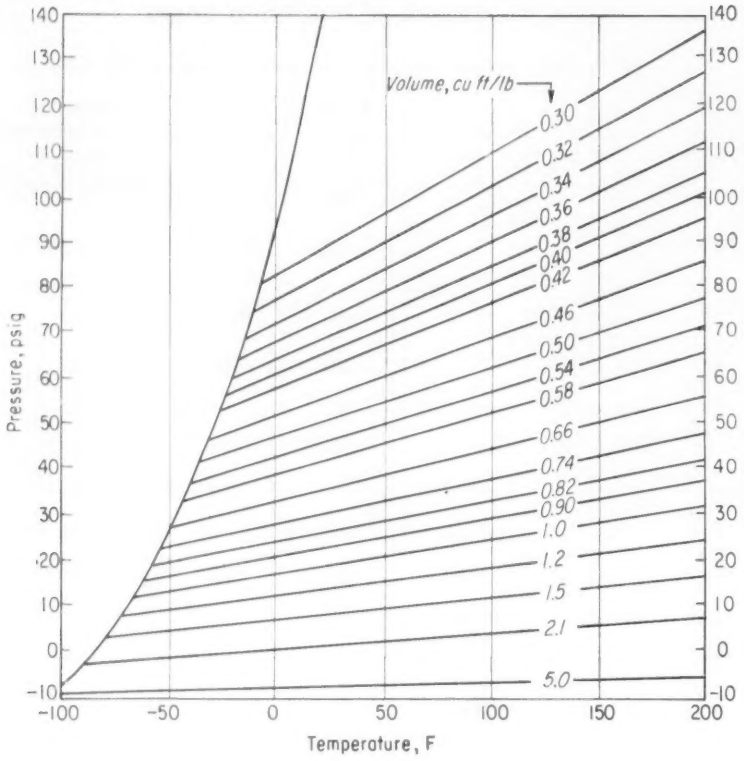
Gaseous fluorocompounds are specifically of interest in high-voltage applications because of their generally inert character and high dielectric strength. Fluorine chemistry has obtained a rather unique position due to the fact that the element fluorine is the most active chemical we have, attacking nearly all other substances with peculiar result that many of the combinations are then among the most inert compounds. For example, fluorine attacks sulfur and the product is chemically, thermally and electrically stable.

The fluorogases of most interest are the Freons, sulfur hexafluoride and the fully fluorinated compounds such as perfluoropropane (C_3F_8), perfluorobutane (C_4F_{10}), and perfluorocyclobutane (octafluorocyclobutane, c-C_4F_8).

While the dielectric strength is one of the factors which is of great importance in the selection of the gas, there are other factors to consider. The more important are: boiling point, vapor pressure, toxicity, chemical inertness, thermal stability and price. Some gases are very expensive.

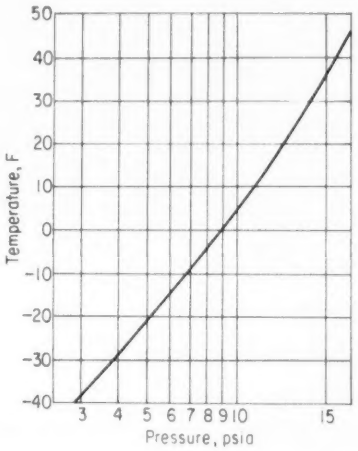
A large number of compounds have been investigated as potential gaseous dielectrics. The best gaseous dielectrics are characterized by having fairly heavy and complex molecules having a high percentage of fluorine. Gases can be divided into two groups—attaching and the non-attaching gases. By attachment we mean the ability of gas molecules to seize an electron and thus form a negative ion. This property makes important differences in the mechanism of gas breakdown—this can be visualized if process of attachment is thought of as the opposite of ionization. Where the ionization process is trying to release, the attachment process endeavors to remove free electrons. In the limit, if the attachments were carried on at a rate equal to ionization, then no breakdown would be possible by electronic ionization. In a purely qualitative sense this property of the so-called *electronegative gases* can be described as that of a sponge—a sponge which soaks up free electrons coming in contact with it.

Sulfur hexafluoride, among the electronegative gases, has achieved widespread commercial use. It is physiologically inert (no toxic effects are seen in test animals after prolonged exposure to mixtures of 80% SF_6 and 20% oxygen); fire resistant; has a dielectric strength of about 2.2 relative to nitrogen (for 60-cycle voltage and uniform field); has good heat conductivity; is stable in the presence of most materials of construction up to temperatures of about 150 C; remains a gas under most conditions down to –60 C; and is available at a moderate price. The 150-C temperature is an arbitrary value sug-



1 Pressure, temperature variation of sulfur hexafluoride at constant specific volumes is shown for volumes in cu ft per lb. Temperature is in deg F, pressure in psig

How pressure and temperature are related in two of the fluorogases



2 Vapor pressure of Freon C318, an insulating fluorocompound, vs temperature

gested by the results of experimental study of thermal stability made in presence of common materials used in the construction of electrical equipment. Under ideal conditions, for instance when heated in a quartz tube, SF_6 is not decomposed up to a temperature of 500 C.

Vapor pressure of SF_6 at its freezing point is two atmospheres, such that it provides gaseous insulation at temperatures substantially below its freezing point.

The sets of curves shown in Fig. 1 show the variation of pressure (at constant volume) for several different initial fillings. Thus, if a constant volume is filled, say at 10 psig at 60 F, the pressure at 160 F will be 15 psig while at –40 F the pressure will be 5 psig. Throughout this change in the pressure, if the vessel is tight the dielectric strength will not change because the density (the number of molecules) of the gas is not changed.

Condensation is a matter of a serious concern if the equipment containing a rather high boiling gas must operate outdoors in a cold climate and if the electrical strength of the unit depends upon all the gas being in the vaporized state. This problem is one that can be attacked by the use of multicomponent gas mixture often without a reduction of the total dielectric strength. To a first approximation the pressure of a mixture will follow the normal physical chemistry rule of the partial pressures. Thus, for instance, the vapor pressure of c-C_4F_8 is shown. This compound has a boiling point of 21.1 F. This means that in a closed container with the gas at 15 psia it begins to condense as soon as the temperature drops to 21.1 F and then pressure in container follows the curve, Fig. 2.

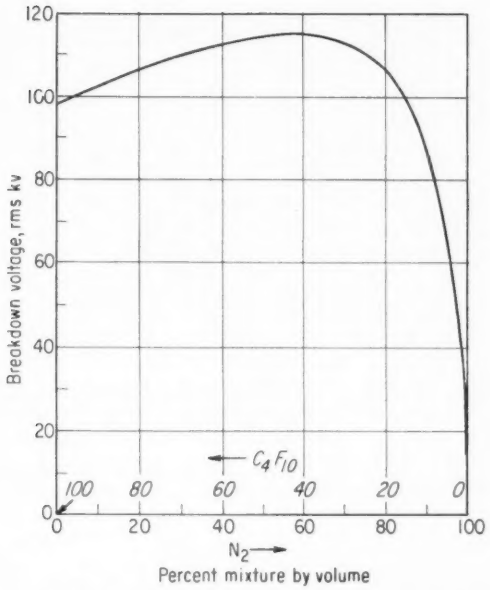
If the container is filled at a pressure, say of 7.5 psia with N_2, and then the pressure is raised to 15 psia with c-C_4F_8 gas the boiling point of the liquid is lowered to –8 F. That is, the gas does not start to liquefy until the temperature is lowered to –8 F. From the dielectric standpoint under special electrode configuration, the dielectric strength of the mixture may be only slightly less than with pure c-C_4F_8, see Fig. 3.

Relative strengths of well-known fluorocompounds, gases and vapors tested under the same conditions are given in the table on p 63. The table also gives some of their physical properties. It will be noted that the dielectric strength is directly proportional to the boiling point and to the molecular weight.

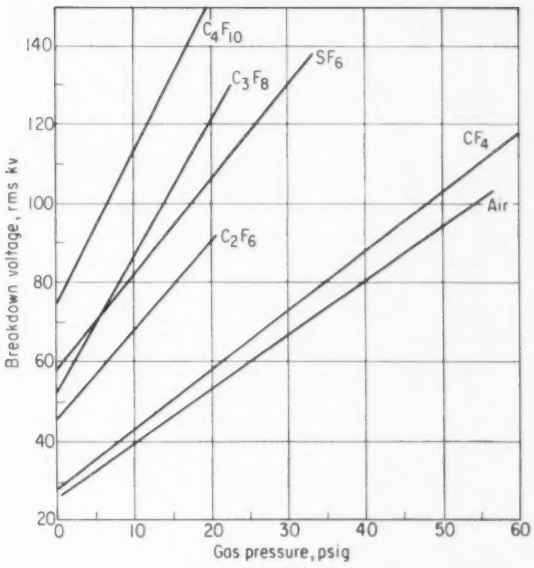
In a uniform field the factors which control the dielectric strength are: type of gas, pressure, spacing, time of applied voltage and electrode metal. Figure 4 shows how the dielectric strength varies with the pressure and for different gases.

In the case of SF_6 gas in a uniform field, Fig. 5 shows the 60 cycle and positive impulse strength at a pressure of 15 psig and as a function of spacing of the electrodes. Data are shown for air at zero psig and transformer oil.

Electric field when not uniform produces large differences between the voltage at which corona starts and when the breakdown occurs, and in case of impulse volt-



3 Mixture of two gases lowers boiling point to suit ambient temp. Test made with ¼-in. square rod to plane, 1 in. apart at 15 psig



4 Dielectric strength of various fluorogases in a uniform field; two 3-in. round-edged plane-to-plane electrodes spaced ½ inch

age large differences are frequently noted depending on the polarity of the electrodes. Table, right, shows the large difference in the values of voltage at which corona and breakdown occurs during impulse test (1.5 to 40 microseconds) between a ¾-in. diameter square-cut rod to plane electrodes.

Corona formation as can be seen occurs for the negative electrode at lower voltage than the positive electrode. However, the breakdown voltages are much higher than the values obtained when the point is positive because space charge formation at the negative rod is effective in shielding the electrode.

Large differentials between the voltages at which corona is formed and the actual breakdown values show that the rating of a given insulation structure should not be based only on breakdown values if the design comprises nonuniform fields. The table also shows that while the difference between the corona onset voltages at the two polarities is not considerable, the impulse flashover voltages with negative rod are more than double those with the rod positive.

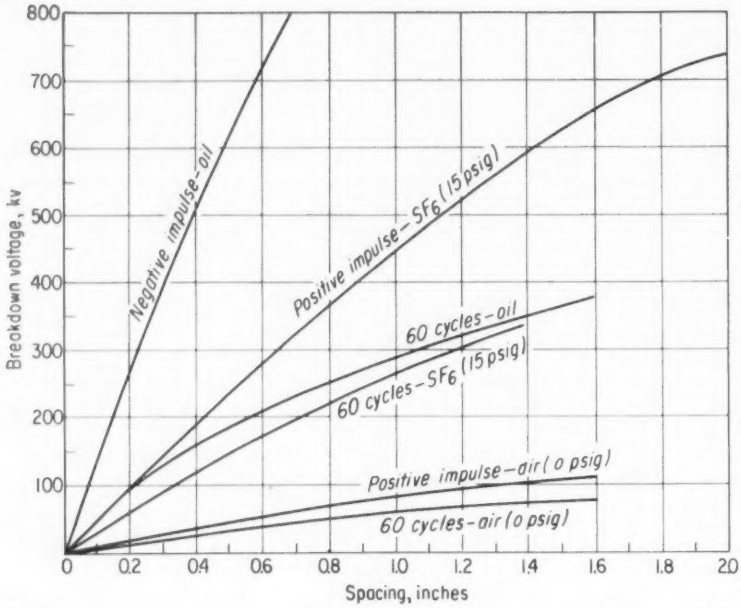
Wide separation between corona and breakdown values is due to what has been termed *corona stabilization.* After corona is formed the electrode configuration is, in effect, changed; the field is improved and the voltage at which breakdown occurs is raised considerably.

In a uniform field the dielectric strength varies directly with the pressure, as was shown previously. The pressure dependence characteristic of the uniform fields does not hold true for the nonuniform fields. In some cases the strength of the electronegative gases actually decreases with pressure. This anomalous behavior of the nonuniform fields is possessed also by mixtures of gases in which one component is electronegative as is O_2 in air. This peculiar behavior is shown in Fig. 6. The dielectric strength at 1-in. spacing and at 15 psig is much lower than the dielectric strength at 5 psig. When SF_6 gas is mixed with nitrogen, the peculiar behavior is shifted to higher pressures or at higher electrode spacings than the pressures and spacings of the pure gases.

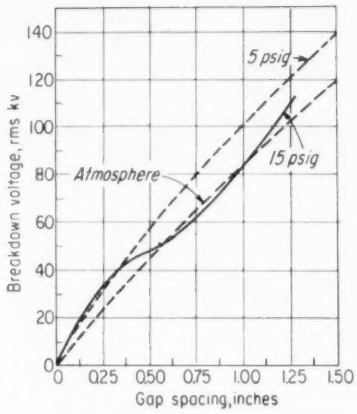
Comparison of dielectric strength of gases at moderate pressure with dielectric strength of oil is only valid for simple electrode configurations. Figure 5 shows the

Corona onset and flashover

Pressure, psig	Spacing, inches	Corona onset, percent voltage		Flashover, percent voltage	
		Point−	Point+	Point−	Point+
0	1	92	100	200	110
15	1	125	128	254	145
0	6	85	100	324	162
15	6	132	140	354	147



5 Relative dielectric strength of oil and sulfur hexafluoride gas at 15 psig in a relatively uniform field (10-in. sphere to plane) at both 60-cycle and impulse tests



6 Breakdown voltages on 60-cycle test of ¼-in. square rod to plane in SF_6 gas

relative dielectric strength of oil and SF_6 gas at 15 psig in a relatively uniform field (10-in. sphere to plane) at both 60-cycle and impulse tests. Since ordinarily oil transformers are tested with negative polarity waves and gas transformers (dry type transformers) with positive waves, the relative strength is shown with these polarities.

At present, SF_6 gas at 15 psig does not compare favorably with G.E. 10C oil. It appears that the dielectric strength of oil can be reached when the gas is operated at 30 psig if the electrostatic fields are fairly uniform. In any case, corona appearance is main consideration.

Toxicity of organic fluorine compounds is not well understood. Some are among the least toxic of substances, while others are among the most poisonous known. The fully fluorinated fluorocarbons (C_3F_8, C_4F_{10}, etc) and SF_6 are the least toxic of the organic compounds.

The relative toxicity of the gases after arcing is principally dependent on the formation of reaction products. Results on arced SF_6 showed that definite low concentrations in air produce no serious physiological effect. For example, with 7.5% or less of the arced gas, there was no harmful effect on test rats; with higher concentration to 20% and exposure for 10 minutes, slight signs of irritation in the lungs on autopsy after 24 hours were noted.

Methods of purifying arced gases have been determined to be most practical and effective when absorption is used. Activated alumina as an absorbent was found efficient in removing the decomposition products of SF_6.

Heat absorption rate of SF_6 gas is much higher than that of air. This is due to the fact that the product of the specific weight (density) and the specific heat for SF_6 gas is higher than that of air. Thus, if SF_6 gas is forced through the core and coils of a transformer, the temperature rise (in and out) of the gas is lower than if air were used. Note that this temperature rise depends only on the volumetric flow (cfm) and on the density of the gas and is independent of the cooling equipment used. The specific heat of SF_6 ranges from 0.155 Btu per lb at 20 C to 0.184 at 100 C while for air heat is 0.242 at a wide range of temperatures. The specific weight of SF_6, however, is 6.093 grams per liter while that of air is 1.293. Therefore, from the standpoint of heat absorption SF_6 is:

$$\frac{0.155 \times 6.093}{0.242 \times 1.293} = \text{about 3 times as absorbent as air.}$$

This means that for a certain volumetric flow of SF_6 flowing through, say, the core and coils of a transformer which is dissipating heat, the temperature rise of SF_6 gas would be one-third of that obtainable if air were used.

As in the previous analysis, it can be shown that the temperature rise of a winding cooled by forced convection is much improved by the use of SF_6 over air because of the higher density of the gas with respect to air considered both to be at the same pressure.

Gaseous dielectrics, it can be seen, offer characteristics competitive with the established insulators. Thus, under certain conditions, the dielectric strength of gases is superior to that of liquid or solid insulating materials. In addition to dielectric strength, physical and chemical properties are also factors to be considered in the selection of a particular gas.

Sulfur hexafluoride maintains a general excellence through its combination of favorable properties. It should be remembered, however, that fluorine chemistry is only a few years old, and without doubt, new gases will be developed with improved characteristics over SF_6.

In February we gave you test results comparing stainless and admiralty condenser tube performance. Here's an analysis that indicates . . .

Condenser test results, theory agree

By J F SEBALD, Worthington Corp

The article "High heat transfer for stainless" last February (pp 75-77) reported the results of heat-transfer tests on condenser tubes in service. Tests compared U values for stainless steel and admiralty tubes working in separate halves of the same condenser. Test heat-transfer values were calculated from recorded test data—river-water temperature rise, condenser backpressure, steam flow and temperatures, water velocity. Results were actual, not theoretical. Now, to complete the picture, here are theoretical calculations that indicate how test and theory compare.

Calculated results come from equations and published data. McAdams' equation yielded conductances for inside of tubes. Equation was modified by recently published NACA data and by HEI condenser-tube test results. Resistances for tubes' steam side come from the Nusselt equation, also modified by HEI experimental data and by the Wallace and Davidson data).

Published values of thermal conductivity supplied data needed to get resistance to heat flow through the tube walls. Finally, a resistance of 0.000240 was chosen to represent the effect of oxide on new, clean admiralty metal. This same value was also used for stainless tubes; the feeling being little error would result from the dual use of the value. Table, below, shows the different resistance values. Velocities of 5 and 8 ft per sec were interpolated from tests 8, 9 and 10 of February article.

Results. Ratio of theoretical U values (stainless to admiralty) ranges from 83.2 to 86.3% with an average of 84.7%. Test result ratios were higher, the average being 94.0%. In all tests the difference between theoretical and actual resistance is less for stainless steel than for admiralty.

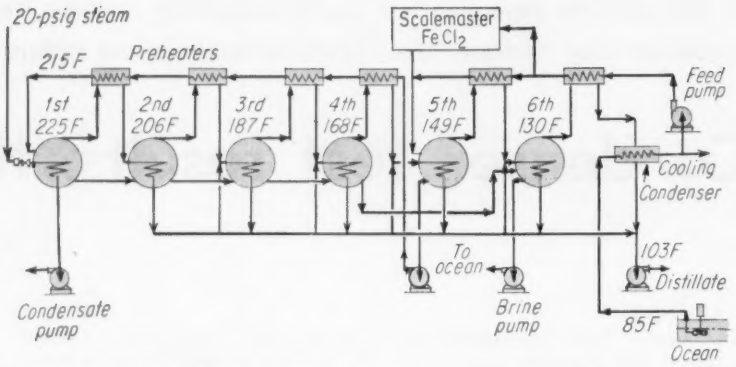
Difference between actual and theoretical resistances for stainless is 24.4% of the total heat transfer. The difference for admiralty tubes is 32%. (Percentages come from average of resistances in all tests.) Much of the spread comes from fouling effect due to corrosion, scale, dirt, organic matter. In this application, it is reasonable to expect stainless to foul less than admiralty.

Predicting cleanliness shows stainless should come out 75% clean, admiralty 71% clean. Prediction is based on theory and experience, and uses an in-service fouling factor to get the relation between theory and test results. A fouling value of 0.0009 gives the above percentages. It lies halfway between 0.0005 for a mechanically cleaned tube and 0.0013 for a tube after service. The cleanliness values, theory and test results in general are in satisfactory agreement.

Theoretical resistances and U values compared with test results

Test number ➤	8				9				10			
Cooling-water inlet, F	66.4				74.0				80.7			
Material	SS	SS	Adm	Adm	SS	SS	Adm	Adm	SS	SS	Adm	Adm
Velocity	5	8	5	8	5	8	5	8	5	8	5	8
Estimated steam load, pounds per hour	226,000	224,000	226,000	224,000	226,000	224,000	226,000	224,000	227,000	226,000	227,000	226,000
Resistance, fouling new tube	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240	0.000240
Resistance, tube wall	0.000348	0.000348	0.000068	0.000068	0.000348	0.000348	0.000068	0.000068	0.000348	0.000348	0.000068	0.000068
Resistance, steam side	0.000824	0.000575	0.000855	0.000596	0.000790	0.000550	0.000813	0.000570	0.000760	0.000544	0.000755	0.000562
Resistance, water side	0.000400	0.000411	0.000404	0.000416	0.000388	0.000399	0.000389	0.000401	0.000379	0.000368	0.000379	0.000366
Total resistance	0.001812	0.001574	0.001567	0.001320	0.001766	0.001537	0.001510	0.001279	0.001727	0.001500	0.001442	0.001236
U value, theoretical Btu/hr-ft²-deg F	551	635	639	758	566	651	662	783	580	677	694	810
U value, test Btu/hr-ft²-deg F	407	470	450	512	425	500	450	525	455	510	480	525
Total resistance, test	0.002460	0.002130	0.002220	0.001952	0.002360	0.002000	0.002220	0.001905	0.002200	0.001960	0.002080	0.001906
Resistance difference	0.000648	0.000556	0.000653	0.000632	0.000594	0.000463	0.000710	0.000626	0.000473	0.000460	0.000638	0.000670
% clean	73.9	74.0	70.4	68.4	75.1	76.8	68.0	67.0	78.5	75.5	69.2	64.8

Abstract of ASME semi-annual-meeting paper by G E Sonderman of Singmaster & Breyer describes teaming up of backpressure turbine-generator plant with a sea-water distillation plant. Water-short areas watch as . . .



SIX-EFFECT EVAPORATING PLANT has 7 evaporators, 2 in parallel for 5th effect; produces 370-gpm fresh water from 605 gpm sea water, uses 3860 gpm for condensing

Giant sea-water converters start

The Government of the Island of Aruba in the Dutch West Indies, some 15 miles off the coast of Venezuela, SA, started running its new $10.6 million salt-water conversion plant in June 1958. The 2.7 mgpd capacity makes this plant the largest in the world and the only water supply for the 55,000 souls on the island. The 14-in. annual rainfall does not even make a secondary source of water for the island.

Aruba must buy the fuel oil for the plant from the local refinery at the going commercial price. High efficiency is mandatory for economical operation. The distilling plants at Kuwait have very cheap fuel and cannot be compared economywise.

Aruba's power demands and costs were rising on its existing diesel-driven power plant. A steam-electric plant exhausting to a water distilling plant offered marked advantages. As a byproduct of the combined plant, electricity costs less than 3 mills per kwhr.

Applying the normal wholesale rates of power to the cost of water evaporation could drop the price to about $1.25 per 1000 gal, compared to the $2 to $3 normal cost.

Providing good water and moderately priced electric energy assures future development of the island. Elaborate tourist facilities are being erected as well as a hydroponic or soilless farm to produce fresh fruit and vegetables, normally imported. The vast Lago Oil & Transport Company refinery buys the plant's water.

Distilling plants still prove to be the most suitable way of evaporating sea water. No other process has been demonstrated long enough and on a large enough scale to warrant choosing it for a commercial plant with public utility reliability.

Evaporators offered by G & J Weir Ltd of Scotland were chosen because they were : (1) made of British cast iron and (2) guaranteed scale free with a newly developed chemical treatment. Stills of British cast iron have been in service at Curacao and Aruba for more than 20 years without severe corrosion.

The plant has five independent sets of 6-effect evaporators. Each set has a capacity of 2000 metric tons, or 540,000 U.S. gpd. Total capacity provides for future growth. The submerged-surface evaporators pass heating steam through horizontal tube coils completely immersed in salt water.

Steam at 20 psig heats the first effect of each set. The control valve feeds steam at 12 psig to the coils. A pump passes the coil condensate to the deaerating heater at 244 F, higher than in most distilling plants.

The 1st-effect vapor at 225 F gives up some heat to preheat the sea-water feed and then enters the 2nd effect as heating steam. This repeats with lowering temperatures down to the 6th effect where incoming sea water condenses the vapor, see sketch above. The six effects yield almost 5 lb of distilled water per lb of steam.

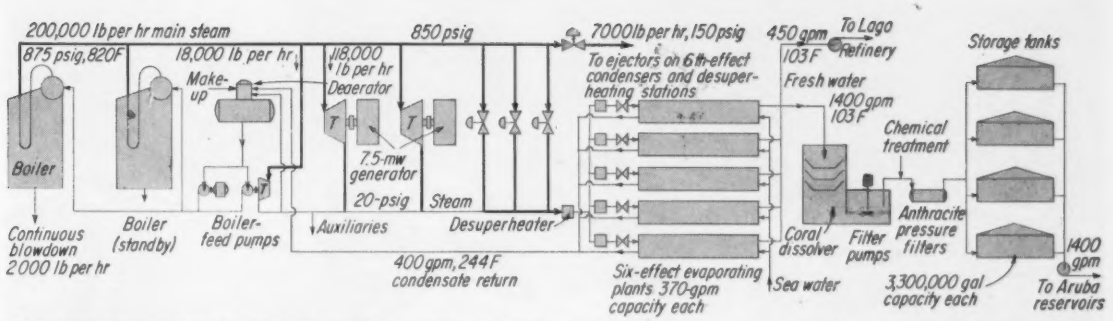
The distillate is guaranteed not to have more than 10 ppm of total solids, starting with sea water at 35,000 ppm. From startup the plant product has had solids as low as 2 to 3 ppm.

The sea water, being free from floating matter and clean, enters the cycle through ¼-in.-mesh stationary monel metal screens. Chlorination at the circulating pump inlets prevents algae growth which fouled and plugged heat-exchanger tubes prior to treatment.

Incoming sea water first cools the distillate and then enters the 5th-effect evaporator shell. Here a ferric-chloride chemical treatment prevents scale deposition in the earlier effects.

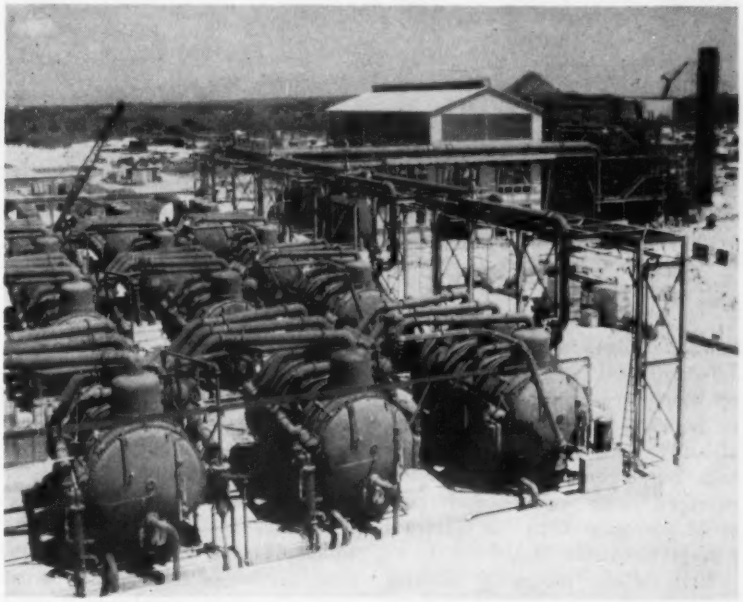
Water enters the 1st-effect shell at just below evaporation temperature. A portion distills off and the balance passes to the 2nd shell—and so on to the cycle end where the concentrated brine discharges to waste. About 60% of the sea-water volume evaporates. The final concentration of solids in the brine, about 9%, is still too thin for effective recovery of the minerals.

The chemical treatment in the 5th effect needs additional disengaging



COMBINED POWER AND DISTILLING PLANT uses 875-psig 820-F steam produced in two outdoor boilers to generate electric energy and evaporate sea water to fresh water. Deaerator heats condensate returning from the evaporator as feedwater for power boilers

in Aruba



SUBMERGED-TUBE EVAPORATORS of five distilling plants, running off picture, *left*, receive 20-psig steam from turbine-generator plant, *right*, equipped with outdoor boilers

surface, so this effect has two shells in parallel. This gives seven vessels in each 6-effect evaporating set, a total of 35 vessels in the plant. Each shell is about 11-ft dia and 30-ft long; total distilling plant occupies an area about 175x300 ft.

Chemical treatment. Sea water may be heated to 140 F without forming scale on heating surfaces. We can't evaporate efficiently with so low a starting point when an 85-F seawater temperature limits the end of the cycle. For years we have distilled water at 190 to 212 F and let scale form. The scale is removed by shutting down and knocking it off with hammers. A more modern development uses flexible heating surfaces that will bow when they're suddenly cooled and crack off the scale.

Some chemical treatments add compounds that prevent scale up to about 195 F. These break down at higher temperatures. To use the 225-F starting temperature at Aruba we chose a ferric chloride treatment. This chemical enters the evaporating plant at the 5th effect at 149 F and prevents scaling at higher temperatures.

Ferric chloride has not been widely used because of its corrosiveness and higher cost. In the Scalemaster process of G & J Weir Ltd used at Aruba, two electrolytic tanks produce ferric ions in proportion to the sea-water flow to the evaporators. By hydrolysis, the ferric ions react with the calcium carbonate in the sea water and form a ferric hydroxide sludge, which is nonscale forming.

Power plant. Two turbines of 7.5-mw capacity each take steam at 850 psig and 820 F. They can generate 12.5 mw byproduct power at full water production capacity. Plant auxiliaries use about 2.5 mw. The balance of 10 mw was judged adequate and so a higher initial pressure was not needed. This set the steam temperature at 820 F for a 20-psig backpressure exhaust, sketch above.

The two turbines are both noncondensing because we expect water demand will exceed electric demand. The extra steam bypasses the turbines through a pressure reducing and desuperheating station.

If the future balance should need greater electric output, a condensing turbine could be installed—or the distilling plants could be used as condensers storing or even wasting the

ARUBA SEA-WATER CONVERTER has backpressure power plant with outdoor boilers, *left*, five 6-effect evaporating plants with seven shells each, *lower center*, four fresh-water storage tanks, *center*, ocean at *right*. Small obsolete conversion plant, *upper right*

surplus distillate for short-term peaks.

Two 200,000-lb-per-hr outdoor boilers supply steam through the turbines to the water plant. They burn high-viscosity Venezuelan fuel oil with a high sulfur content. Air preheaters equipped with steam-heated coils avoid corrosion from the sulfurous gases at low loads.

High winds constantly blowing across the island made it advisable to enclose the turbines, control rooms and electrical switchgear.

The steam cycle has no regenerative heaters. A deaerator heats the condensate returning from the evaporators, and makeup, with the 20-psig exhaust steam. The deaerator has a 10,000-gal storage tank.

The pressure-reducing stations are designed to break down 850-psig 870-F steam to 20 psig and 264 F. Higher temperature would scale up the evaporators. While the pressure drops in one step through a double-seated valve, actuated by a power cylinder, the temperature drops in two stages. The first is a steam-atomized water spray in the 36-in. main exhaust heater to the water-distilling units; this drops the steam to 350 F. Then, at each of the five evaporating sets, a venturi type desuperheater limits the final temperature to not over 5 F above saturation temperature.

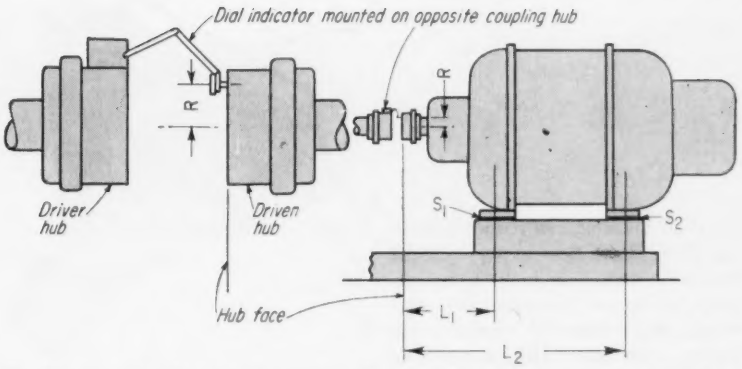
Water after treatment. The Aruba distillate has a slight acidity with a pH about 5.6. The nearly complete absence of salts gives it a flat taste. The Arubans give it a satisfactory taste by trickling the water over beds of broken coral gathered from the local beaches. This treatment: (1) aerates (2) neutralizes and (3) restores some of the minerals by solution from the coral. This leaves the water amply soft for domestic uses. An automatic pH control system adds soda ash for full alkalization.

The water is fluorinated before entering the four 3.3-million-gallon storage tanks. The distillate being completely bacteria free needs no chlorination.

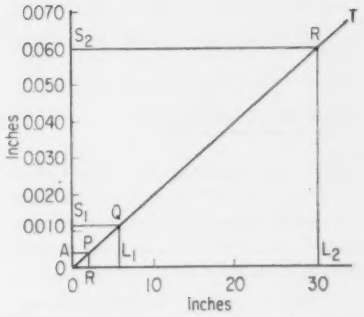
Water for the Lago Oil & Transport Company is used for boilers and process in its refinery, as well as personnel. The total solids must not exceed 5 ppm and there are limits on dissolved oxygen and iron. The only after treatment for this water before it enters the 10-km pipeline adds caustic soda and sodium hexametaphosphate; an automatic pH controller adjusts acidity.

Future possibilities. To date the only large commercial conversion plants use distillation. Production economy depends on low-cost energy and low capital investment. With free energy, distilled water could be produced for about 40 cents per 1000 gal. Such free energy might be found in waste heat from diesel engines or gas turbine exhausts.

Cheap energy might be found in steam-electric plants by expanding steam to about 5 psig. With modern high throttle pressures, reheat and regenerative heating the amount of energy generated by expansion below 5 psig will be less than 20% of the total. This might translate into low-cost energy for sea-water distillation. This could produce water for a cost of less than 60 cents per 1000 gal, good in some areas.



1 Alignment of turbine-driven generator: depends on runout measured at coupling faces and proper shimming under generator supports, must be made horizontally, vertically



2 Proportioning chart relates shimming adjustment to machine-shaft dimensions

Couplings deliver the turbine output to the driven machine as the last link in the chain of energy conversion. Accurate alignment and balancing must be achieved for good turbine performance. Let's study the . . .

Twin steps to good coupling operation

By ALBERT M DRYER, Controls Engineer,
Small Steam Turbine Department, General Electric Company

A coupling should transmit power from prime mover to load quietly. It must: (1) compensate for misalignment from temperature shifts (2) isolate driven equipment from driver axial shaft thrust and vice-versa (3) never cause vibration that might damage bearings or itself.

Alignment. Misalignment usually is the major cause for rough coupling operation. It may be caused by: distortion of the driver or driven equipment by temperature change, distortion by pipe strain, foundation settling, or by poor initial alignment.

For example, consider what happens during startup to a turbine using 750-F steam driving a refrigeration compressor working at –30 F. Some manufacturers publish curves for predicting alignment changes caused by temperature shifts. These can be helpful, but aren't too accurate due to other factors involved.

Most field engineers align the shafts at ambient temperature, run the machines until they are up to temperature, then shut down and quickly make a hot check. The latter is most important in the alignment procedure. It can compensate for most unknowns when done quickly and accurately.

The hot check can be made several ways. With the coupling flanges parted, offset or parallel, misalignment can be checked with a straight edge while annular misalignment can be checked with a taper gage. For greater accuracy a dial indicator sweep can be made of the coupling hub face and outside diameter. Coupling instruction books show these and other methods.

Once the hot alignment check has been made, all corrections can be made simultaneously with Poston's rule. Fig. 1 shows a small generator to be aligned with the prime mover. To correct angular misalignment make the following measurements:

1. Axial distance L_1 measured from face of coupling to front support.

2. Axial distance L_2 measured from face of coupling to back support.

3. Radius R from center line of shaft to radius at which angularity measurement is made.

4. Angularity reading A shown by dial indicator or taper gage. (Note that $A = \frac{1}{2}$ total indicated runout.)

With this information proceed to construct Fig. 2 as follows:

1. Lay out point P with coordinates A on vertical scale and R on the horizontal scale.

2. Extend straight line through origin and point P to T.

3. From L_1 on horizontal scale project vertically to intersect OT at Q. Red S_1 on vertical scale—the shim thickness needed at front support.

4. In similar way lay out L_2 to find S_2, shim thickness at rear support. For example, in Fig. 2 we have a generator with feet 6 and 30 in. from the coupling face. The angularity check shows a total indicator reading of 0.008 in. at a 2-in. radius with the

largest separation at the top. Locating P at 2 in. and A at 0.004 in. fixes curve OT. Spotting L_1 at 6 in. we find $S_1 = 0.012$ in. under the nearest feet. Spotting L_2 at 30 in. we find $S_2 = 0.060$ in. under farthest support; this corrects angular misalignment.

If the shafts have some parallel misalignment as well, this should be corrected by adding or subtracting an equal thickness of shims from both front and back supports. Horizontal misalignment would be corrected by shifting generator parallel to itself.

Field balancing. Vibration persisting after aligning the coupling means that the coupling must be balanced. Usually balancing is limited to one plane. We should observe a few general rules:

1. Balancing needs accuracy in reading speed and vibration. Unfortunately couplings may have to be balanced as the equipment approaches resonant speeds where vibration amplitude and phase angle change rapidly with speed. Speeds must be held accurately from trial to trial so vibration readings can be compared. Vibration readings must be taken at several speeds to guard against errors. For instance, when balancing at 8000 rpm take readings also at 7000 and 7500 rpm. A set of readings should also be taken at the highest speed (up to trip speed) that can be held without excessive vibration.

2. A lightbeam indicator, Fig. 3, helps in taking vibration readings directly from the shaft with the aid of a shaft stick, Fig. 4. The stick made of hardwood or Masonite, well lubricated, minimizes shaft chatter. Carbon or Teflon tips are useful on high-speed sets.

To take a vibration reading hold the stick firmly but lightly against the shaft. Use just enough pressure to prevent the stick from bouncing on the shaft. Place the lightbeam indicator on the table of the stick and read. Take horizontal and vertical readings; the latter is more reliable.

3. The traverse method is surest, but shaft marking can reduce balancing time. Regardless of method, the unbalance angle should be found accurately before changing the trial weight size. Even if marks prove useless, shots taken with them can be used as part of the traverse, so no effort has been lost.

4. Shaft marking can be done by two methods. In the first, hold a crayon closer and closer to the rotating shaft until the high spot just touches the crayon. The shaft should first be washed with a good solvent to prevent smearing the marks. For hot shaft or ambient temperatures use several crayons cooled in dry ice.

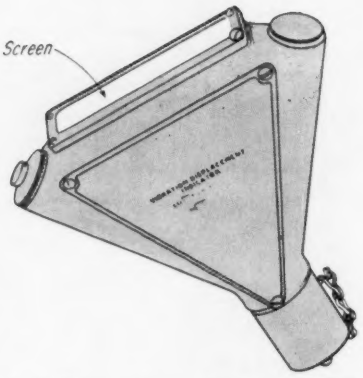
In the second method coat the shaft with whiting and use a sharp stick brought gradually closer to the shaft until it touches the high spot. Mix the whiting with a volatile solvent and spray it on the shaft with an insect sprayer. With either method make a series of marks, because some are sure to be smudged. Mark as close to the coupling as possible because the larger vibrations make shorter, more reliable marks. Mark both driver and driven shafts.

5. Coupling bolts often become stripped during balancing, so have a few extras on hand. When replacing a bolt, make sure the new one weighs the same.

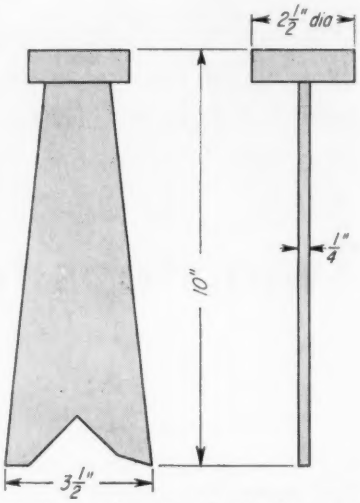
6. For finer angular correction, the balance weight may be split between two bolt holes. Table, facing page, shows how split weights should be divided in relation to the weight needed.

7. Occasionally, a balance correction improves one shaft but further unbalances the other. This may indicate a *couple* or *dynamic unbalance*. Shaft marks on the driver shaft diametrically opposite to those on driving shaft indicate this unbalance.

Spacer type couplings are most likely to have couple unbalances. Balance correction should be made in both coupling flanges in diametrically opposite pairs. Very small weights are normally needed. In standard couplings this same effect may be achieved by switching weight from under the bolt heads on one side to under the nuts on the other.



3 Lightbeam-type vibration indicator helps align, measure coupling action



4 Shaft stick used with vibration meter rides turbine shaft, avoids chatter

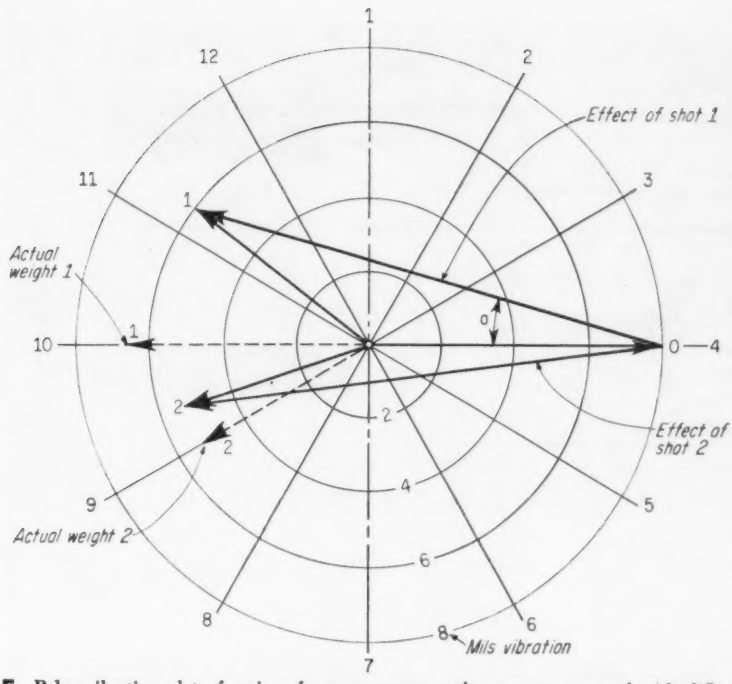
Shaft marking. A good standard procedure uses the following steps:

1. Bring machine up to speed where vibration is excessive, say four mils.

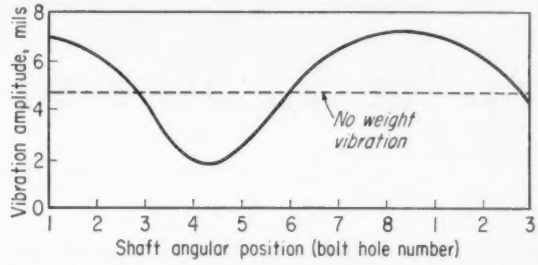
2. Reduce speed to make vibrations about 2 or 3 mils and take complete set of shaft and bracket vibrations on both driver and driven equipment. Take both horizontal and vertical readings.

3. Increase speed in 500 to 1000 rpm increments, taking a full set of vibration readings at each point.

4. When shaft vibrations reach 5 or 6 mils, or further increase seems un-



5 Polar vibration plot of series of measurements made at constant speed with different balancing weights makes it possible to figure final weight and position needed



6 Moving trial weight through all bolt holes in coupling in succession will show unbalance point, help estimate weight needed

safe, take a full set of readings, mark the shaft, shut down and record the position of marks on both shafts.

5. Add weight *opposite* the mark; one or two extra lockwashers under a coupling bolt make a good trial weight. Don't be surprised if a very small weight is all that's necessary.

6. Repeat Steps 1 through 4, marking the shaft at the same speeds. Be sure vibration readings are taken at *exactly* the same points, by the same man, with the same instrument, at the *exact same speeds*. When balance has improved, speed should be raised and same vibration data taken.

Fig. 5 shows how a polar vibration plot can be used to find the best position for the next shot, or step, in the balancing procedure. Radius indicates vibration amplitude; angular position shows vibration angle. Vibration for the initial *no-weight* shot is vector *0*. Vibrations at the end of shots 1 and 2 are shown as solid vectors *1* and *2*.

The balancing procedure for Fig. 5 may go as follows: During the first shot an 8-mil vibration was measured at 7000 rpm. The shaft mark shows this at position 4. This locates the vector *0*, on Fig. 5. Next add a weight at the opposite position, 10, noted by dotted vector *1* as *actual weight 1*.

Repeating all vibration readings at 7000 rpm and marking the shaft a vibration of six mils was found near position 11; see solid vector *1*.

Connecting *0* and *1* gives a vector at an angle *a* from the initial unbalance vector *0*. This angle about equals the angle between bolt holes. So the trial weight is shifted to position 9 as shown by dotted vector *2*.

Again repeating all vibration readings at 7000 rpm and marking the shaft, a vibration of 5.5 mils is found at solid vector *2* between positions 9 and 10, almost opposite initial mark.

With the proper position found, a smaller balancing weight needs to be distributed between positions 9 and 10 to reduce the vibration to acceptable level. This whole procedure may take 4 to 5 hours to complete.

Traverse balancing, while needing a longer time to complete, gives a straightforward method of correcting unbalance. We use the same procedure outlined in Steps 1 through 6 for the previous *shaft marking* method just outlined except that the shaft marking is omitted.

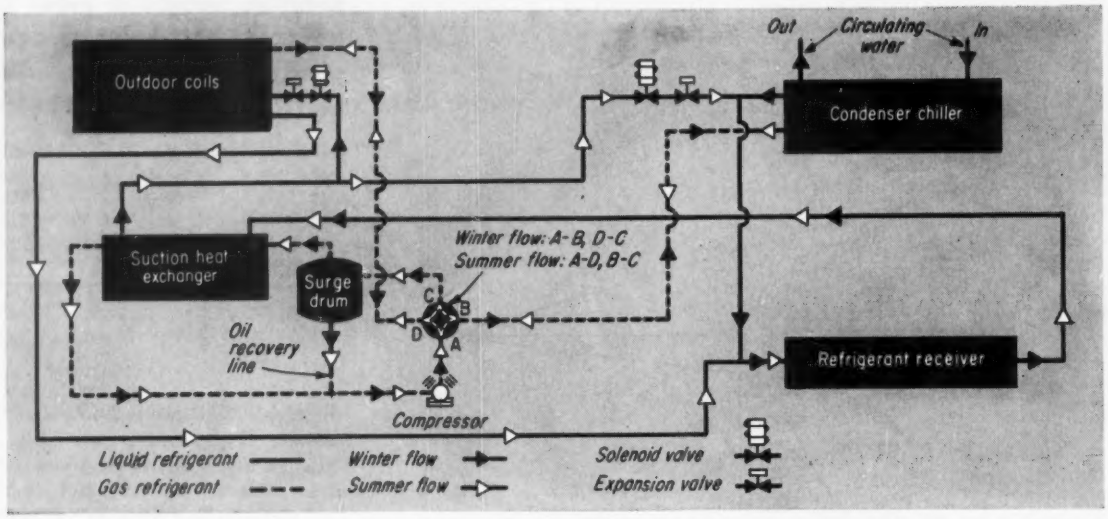
Then in the following steps the trial weight is successively moved through all the bolt holes, each time taking the necessary readings but omitting shaft marking.

For a given speed and pickup location, plot vibration amplitude vs angular position of the trial weight, Fig. 6. This shows that the unbalance is at position 4 on the coupling. We then only need to vary the weight at this position to find the lowest amplitude.

The weight correction can be predicted from the traverse. If the traverse curve never crosses the *no-weight line* the trial balance weight is too large. If the balance traverse curve varies only slightly above and below the *no-weight line*, we know that the trial weight is too small.

Relative weight to place in adjacent bolt holes of coupling to equal unit weight halfway between bolt holes

No. of bolts	Angle between holes, deg	Relative weights
8	45	0.54
10	36	0.525
12	30	0.520



SUCTION HEAT EXCHANGER, *above,* precools liquid refrigerant going to expansion valves. Precooling takes place during both heating and cooling cycles. Heat transfer is from refrigerant to refrigerant, with heat flowing from liquid to gas in both cycles

St. Louis Shipbuilding Co's new 3-story office building is located along the Mississippi. Yet they conditioned the structure with an air source . . .

100-ton heat pump for $3.50 a sq ft

By J W COOK, Kremer-Hicks Co

The Mississippi River flows right by St. Louis Shipbuilding Co's new $400,000 office building. Yet an air-source heat pump conditions the shipyard building.

The river seemed the natural heat-exchange medium for the heat pump. A search of utility company records showed river temperatures vary between 31 and 92F. Also, water level varies widely and river-carried silt is heavy. These facts make the river unattractive as part of an air-conditioning scheme, and lead to the selection of air-source condenser-evaporators.

Loads for the 30,000 sq ft 3-story building come to 78 tons cooling, 780,000 Btu per hr heating. All building space is devoted to office work except for a cafeteria and a 4000 sq ft IBM room.

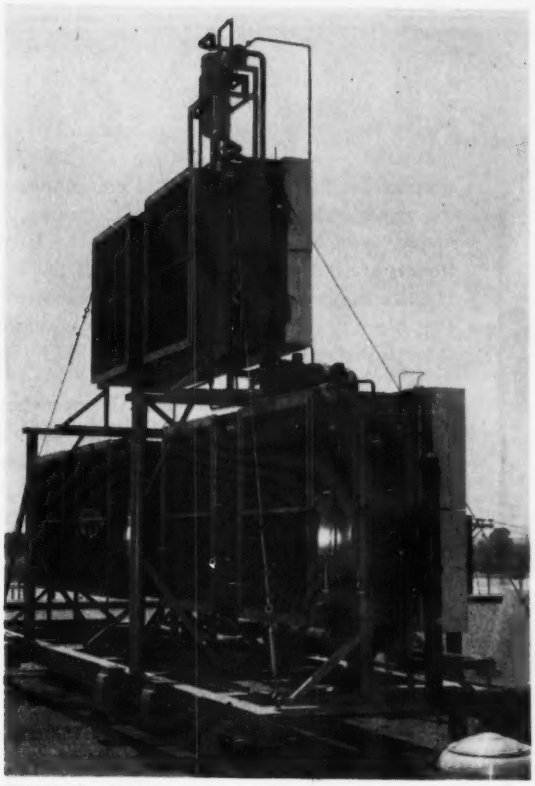
Design points were taken as 0 F outside, 75 F inside in winter, and 95-F db, 78-F wb outside, 80-F db, 50% relative humidity inside in the summer. Compressor heat balance charts indicated the balance point below which auxiliary heat would be needed was –6 F. This balance point included heat gains from people, lights.

Operation data for 1958 shows no demand charge during April and May. During this 2-month interval the Carrier heat pump consumed over 10,000 kwhr per month. Demand charges started in June, continued through September, stopped for two months, then came in again in December. The heat pump kwhr jumped from 21,000 in June to 37,000 in August, back to 28,000 in September. Running kw hours dropped to 7,000 by November, jumped up to 22,000 in December.

Total demand plus energy charge for the nine months came to $1590.37 for 182,170 kwhr, or 0.873¢ per kwhr. Low electric charge results from heavy welding load plus other equipment working at shipyard, making low cost power available for heat pump operation.

Installation charge for entire conditioning system includes both heated and cooled areas. Equipment selected for the system is shown in the flow diagram, above. Although cooling load came to 78 tons, 100 tons of compressor capacity was installed to give a safety factor. A 100-hp double-shaft motor drives one 40-hp and one 60-hp compressor totaling 14 cylinders (6 and 8).

Surge drum can receive all liquid refrigerant suddenly released by the condenser-chiller or roof coils, since the 3-in. 4-way valve action is almost instantaneous. No oil separator is used on the discharge lines, and so far only one problem has come up: A strainer stopped up on the surge tank bottom oil line. A ½-in. hand-operated expansion valve allows flow of oil while preventing liquid refrigerant slugs from reaching the compressor. Liquid refrigerant receiver installed is large enough to hold



ROOF-TOP COILS, totaling 7800 lb, have been maintenance free. Problems of wet snow are solved by manual defrost cycle

the full refrigerant charge of 1000 lb of Carrenne 500.

Dry type roof coils exchange heat between refrigerant and the atmosphere. So far frost and dirt have not been problems, but wet snow completely clogs the fins. Tripping in the defrost cycle by hand solves this problem. Since coil fans are propeller instead of centrifugal, normal pressure-sensing devices are not suitable to detect fin clogging.

Controls. Automatic defrosting is not needed to control frost buildup. A school-bell time clock reverses the heating cycle twice at night and once during the day, at preset intervals. Clock makes contact for one second, energizes a relay whose holding coil is in series with a thermostat on one finned roof coil. When the thermostat senses fin temperatures at which frost cannot exist, it opens the defrost circuit, the relay drops out, and the heating cycle comes back.

Each roof coil unit has two fans driven by one 3-hp motor. If compressor discharge pressure drops too low while system is on cooling cycle, a control circuit drops fan rpm to zero in two steps. This maintains a reasonably constant head pressure. Control signal to change fan rpm comes from pressure switches at compressor discharge.

Temperature of return circulating water controls the compressor loading and unloading. Two modulating temperature controllers — one for summer, the other for winter—translate bulb signals into action. Control is a 4-step process: (1) Temperature-sensitive bulbs immersed in return water line send signals to controllers. (2) These then position a control motor, which in turn (3) drives a camshaft. Along the cam are ten single-pole double-throw mercury switches forming a step controller. This (4) trips solenoid valves controlling compressor gas output. In steps of 4, 8, 10 and 14, cylinders can be brought into refrigeration circuit as needed. A 100-kw water heater cuts in if all 14 cylinders can't handle the heating load and keeps temperatures at desired levels.

Summer-winter master switch positions controllers; no manual adjusting is needed after initial setting. Water for compressor head cooling, done only in winter, feeds into circulating-water system to help in heating.

Low-pressure switches on compressor are set for 27 psig in summer, 1.5 psig in winter. A thermostat protects the condenser-chiller from freezing up by stopping compressor when water temperatures near 32 F. Controls unload compressor at highest water temperature in winter, lowest temperature in summer.

A flash tank at the highest point in the system (over roof coils) bleeds off flash gas and maintains constant liquid refrigerant supply to roof coils during heating. Liquid refrigerant then drops to coils by gravity. During winter, the temperature of the coils drops to –20 F when the ambient air temperature is at zero.

Air distribution is to standard under-window fan-coil units. Water temperatures to these units varies from 105-115 F in winter and 45 F in summer. Fractional-motor fans in fan coil units provide air circulation. Three-speed controls of motors permits occupants to adjust air flow nearest them.

Capacity of 55 fan coil units varies from ½ to 2 tons. The cafeteria load is 7½ tons. Thermostatically controlled 3-way valves built into fan coil units control room temperatures. Cafeteria is only area using external thermostats. Fan coil unit valves are switched from summer to winter operation, or reverse, manually. Automatic changeover for these valves was not needed.

A single manual summer-winter switch at the motor-control center reverses the refrigeration cycle by positioning the 4-way and solenoid valves. This switch, the manual defrost cycle to take care of snow, and changing flow at the window units are the only manual functions in the system. So far this semiautomatic system has worked well, giving little trouble.

Correction

In the article "Determine film coefficients quickly" (POWER, May 1959, pp 66-67) formula for h_i should read

$$h_i = 0.027 \frac{k^{0.6}\, c^{0.4}\, w^{0.8}}{u^{0.4}} \times \frac{v^{0.8}}{d^{0.2}}$$

In symbol definitions box, units should read *ft per hr* for velocity, *v*, and *ft* for tube ID, *d*. Film coefficients and charts apply only to water.

One Of The Many Features Of The

RILEY TURBO FURNACE

Power Engineers of central stations and of large industrial power plants visiting a Riley Turbo Furnace installation burning coal are impressed at the remarkable cleanliness of the furnace . . . a major reason why more and more Turbo Furnace Boilers are being purchased. Ability of the Turbo Furnace to remain slag-free eliminates the need for slag blowing equipment and sustains an efficient furnace performance indefinitely.

Opposed firing into the Turbo Furnace hearth develops intimate mixing of fuel and air, rapid combustion at high temperature. Coals with widest range of ash fusion temperatures, ash and sulphur content, are suitable. Furnace walls stay clean because combustion gas rises vertically out of hearth in uniform stratum without turbulence and fills entire furnace cross section.

RILEY STOKER CORPORATION
WORCESTER, MASSACHUSETTS

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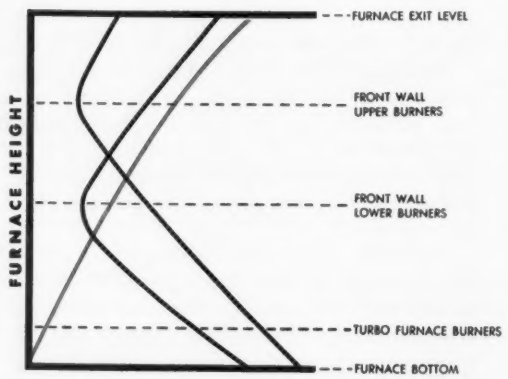
Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

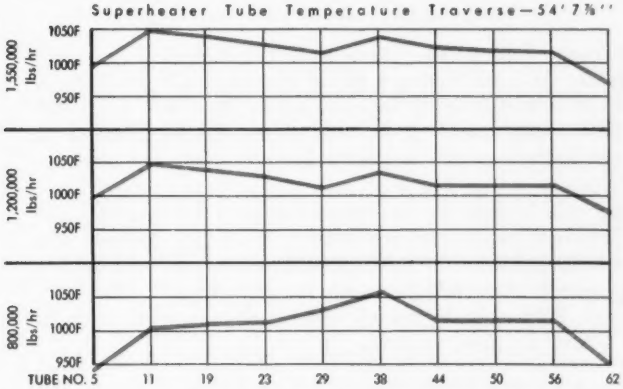


A comparison of temperature characteristics between wall firing and Turbo Furnace firing. Note with Turbo Furnace firing (red curve) highest temperature is at furnace bottom.

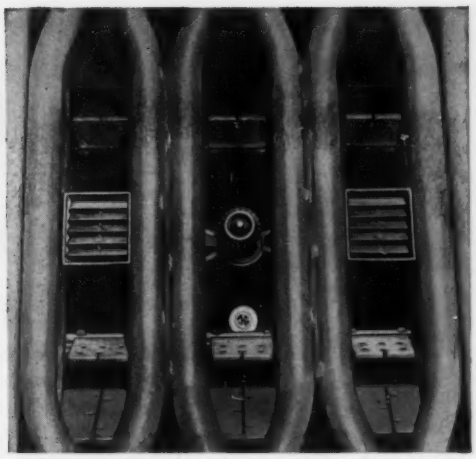
A few of 20 Burners in a 1,550,000 lb/hr Turbo Furnace Boiler. This is a 56 foot wide single furnace.

THERE ARE OTHER TURBO FURNACE ADVANTAGES, TOO!

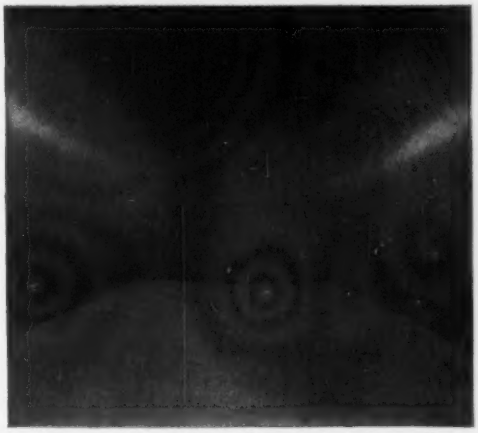
- **Tops For Multifuels** Combustion of coal, oil, gas, fluid coke, produces substantially equal furnace performance resulting in equivalent furnace exit temperatures, simplifying steam temperature control.
- **Eliminates The Flyash Disposal Problem** Reinjected flyash is removed as an easily handled, commercially useful, quenched slag; in some instances flyash from adjacent dry-bottom boiler can be disposed of in the Turbo Furnace.
- **Extra Wide, Undivided Furnaces Are Possible** The opposed method of Turbo Furnace firing removes limitations on furnace width inherent with other methods of firing.
- **Less Space Required** The permissable higher heat release of the Turbo Furnace results in smaller structures for a given capacity.
- **One Level Operation** All Turbo Furnace burners are at one operating level — usually common with the turbine operating level.
- **Minimum Superheater Metal Temperature Variations** Linear flame from side wall to side wall produces uniform heat release throughout the entire furnace width. Furnace gases rise evenly and vertically within the furnace, resulting in a flat gradient of the skin metal temperatures of superheater and reheater tubes.



Curves Plotted From Readings Taken In Tests Conducted July 22, 1958



The Riley Directional Flame Turbo Furnace Burner is a shop assembled unit which can be equipped complete with coal, gas, oil burners and automatic gas ignitors. Adjustable vanes direct air to control flame placement. No refractory is needed.



A highly turbulent linear flame with long residence time of combustibles results from downward opposed firing. Carbon loss is negligible.

The cooled slag pool of a shut-down unit returns to molten stage when unit returns to line. Note slag discharge opening and flyash reinjection ports.

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

Nuclear notes

By B G A SKROTZKI, Associate Editor

Collaboration agreement has been signed by Atomics International Division of North American Aviation, Inc and English Electric Co, Ltd of England to work together in the field of organic-liquid-cooled reactor systems. This broadens scope of English Electric who have worked almost exclusively on gas-cooled graphite-moderated reactor systems for large stations in the past.

ASTM adopts the *rad* for reporting radiation dose. The *rad* represents 100 ergs of energy absorbed per gram of material; it is independent of the kind of ionizing radiation (X-ray, gamma ray, beta ray, neutrons, etc) and of the type of material irradiated. This unit will probably supersede the *rep* (Roentgen equivalent physical), defined as the absorption of 98 ergs per gram from irradiation.

Agreement for cooperation has been signed by the USA and IAEA (International Atomic Energy Agency) in Vienna, Austria. This allows IAEA to draw on the 5000 kilograms of U-235 pledged by the USA in 1956. The USA will also match the 50 kg made available by the USSR and the 20 kg from the United Kingdom. These materials will be furnished at the rates charged by the AEC for domestic distribution. Up to $50,000 worth may be transferred without charge during a calendar year for research on peaceful uses or for medical therapy.

AEC has evaluated the design studies made by different teams of fabricators and consulting engineers for: (1) boiling-water reactor plant (2) organic-cooled reactor plant (3) advanced pressurized-water reactor plant (4) heavy-water-moderated reactor plant, see POWER, Dec 1958, p 112. The reports and evaluation will be available in August from the Office of Technical Services, Department of Commerce, Washington 25, D.C.

AEC analysis concludes that none of the nuclear plants studied is likely to be competitive with conventional plants. AEC anticipates a higher cost of 1 mill per kwhr o more. No major difference in cost of power is expected among the PWR, BWR and OCR as designed. The heavy-water reactor is sensitive to loss of water; loss of 17 gal per day adds 1 mill per kwhr to power cost for a 200-mwe plant.

Modular nuclear power plant will be built by the Martin Company for the AEC and the Air Force, on a cost-plus-fixed-fee contract estimated to total $5.4 million. The PM-1 will be built in factory-assembled units that can be air-transported and quickly connected in the field. They will be movable from site to site as needed. The light-water-cooled and -moderated PWR will be fueled with highly enriched uraniun and produce 1 mwe and 2 mwt for space heating.

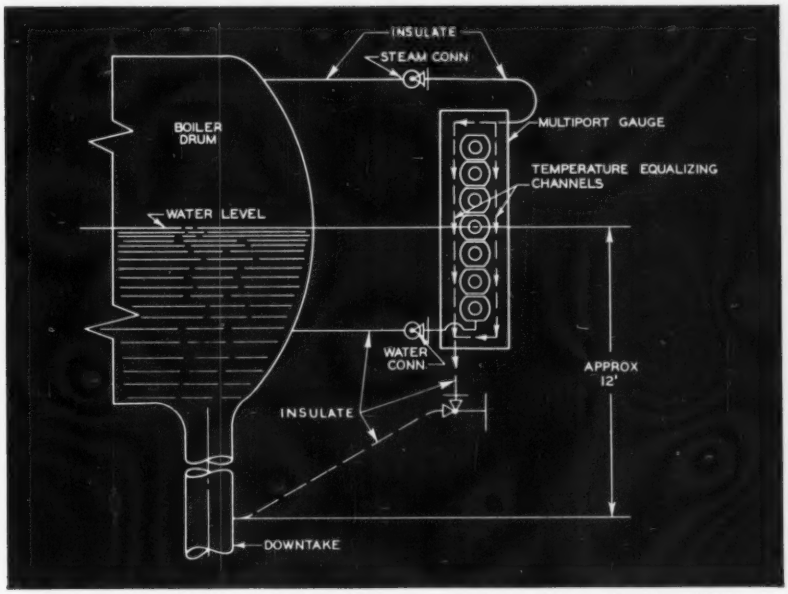
Carbon-arc image furnace develops 5000-F temperature in the AEC Hanford Plant run by General Electric Company to test ceramic atomic fuel elements. Light rays from a water-cooled carbon arc reflect from a parabolic mirror in one end of the furnace to another mirror in the other end. This focuses the rays on a specimen inside a quartz envelope holding a helium atmosphere.

Argonne National Laboratory run by the University of Chicago for the AEC has a new Fuel Fabrication Facility costing $1 million. It will be used for developmental research on fabricating plutonium fuel elements. The fuel elements will be loaded into Experimental Breeder Reactors I and II and also the Experimental Boiling Water Reactor. ERB-II will be the first plant to recycle its own fuel.

Diamond

Temperature Equalizing MULTI-PORT GAUGE*

Improves Accuracy of Water Level Indication at High Operating Pressures



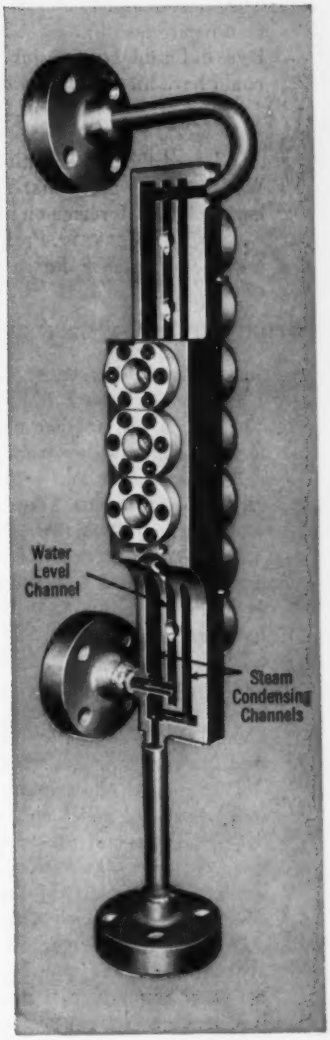
Diagramatic illustration of new Diamond Temperature-Equalizing Multi-Port Gauge installation.

By a simple reliable means the Diamond Temperature Equalizing Multi-Port Gauge* effectively reduces error in gauge level reading at high operating pressures.

Gauge error (resulting from the gauge temperature being lower than boiler saturation temperature) is substantially avoided by introducing supplementary gauge heating in the form of steam condensing channels. These channels are parallel to the gauge water level channel as illustrated, and serve to heat the gauge level channel by direct conduction of heat from condensing steam through the gauge body itself. No external source of energy or control is required. The heating channels have a natural circulation system independent of the gauge level channel so that no faulty operation can occur under any circumstance.

Ask your local Diamond office or write directly to Lancaster, Ohio for Form 2150 for further information.

*Patent Applied For.



Cut-away sections illustrate independent gauge body heating channels of the new Diamond Temperature-Equalizing Multi-Port Gauge.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

8274

DIAMOND SPECIALTY LIMITED—Windsor, Ontario

For more facts circle 238 on Reader Service card, p 99

Reserved for your comment

BOB BELLAS, Associate Editor

Throw the rascals out

Bob Peck's article on plant politics is one of the best I've read since subscribing to your magazine many years ago. ("How you can lick plant politics," May, pp 195-197). I wish all concerned with management in the power-services field could read it.

However, one item he overlooked is the case of the young engineer walking into a plant and getting a good job strictly because of his ability, then having to contend with the older employees' gripes that he's making as much as, or more than, they are. They have seniority and they bitterly resent the new man regardless of how good he is. All in all, though, Peck did a mighty fine job. I doubt if even Marmy could have hit the nail on the head with better aim.

TOM MULLIN, *Seattle, Washington*

. . . I read the article with a great deal of interest. We liked it so much that we are sending copies to key men, from foremen on up the ladder.

J S BENNETT, *President*
Hale Fire Pump Co, Conshohocken, Pa.

Forum for low-water cutoffs

Just so the controversy George Edwards started ("How much is 6 x 0?", March, p 196) doesn't die, let me put another nickel's worth in. I want to expand on my viewpoint.

A water feeder and a low water cutoff are two different instruments. They should not be dependent on the same float and linkage mechanism.

Let me ask: Because a boiler has a pressure control to limit the firing mechanism would it be wise to do away with the pressure relief valve? Or would it be sane to have the safety valve and the pressure control built as a unit, both operated by the same mechanical linkage? I believe that, even if it could be done, engineers would unanimously reject the idea. Yet this same risky mechanical-linkage concept is often used with water-line safety controls.

Take people who continue to make combination water feed and relief valves for hot-water heating boilers. In cases of overpressure, when this control is used, water has to back up through the feedwater pipe (usually ½ in.) to relieve pressure. Would you like to see a steam boiler relieving excess pressure through the bottom, and through 4 or 5 ft of ½-in. pipe? Don't they know that a hot-water heating boiler is a steam boiler when and if it reaches "runaway" conditions?

Some years ago there was a "triple-threat" control called "Triad" on the market. This "thing" was a combination water feeder, pressure control and low-water cutoff in one body, using one bellows to actuate all three functions. I think this one was laughed out of existence, but in its time I saw several dozen of them in use.

Safety is indivisible. Safety controls should be separate from controls for other purposes. And if full safety cannot be had in one control, another safety control should be added. In short, I'm still convinced that maximum safety lies in the second-chance (two cutoffs) philosophy, with the second chance in no way depending on the first.

FRED FEIGENBAUM, *Service Manager*
Barrow Oil Burner Corp, Brooklyn, N. Y.

. . . The article certainly gets the point across that controls need proper maintenance if they are expected to function properly at all times. I am sure that no one will disagree with that fact.

However, to my knowledge three leading boiler and machinery insurance companies recommend an additional low-water cutoff control only when an automatically fired boiler is unattended and equipped with a low-water cutoff and water feeder combined in a single device which, when it becomes inoperative, fails unsafe. I am sure you'll agree that this point throws a different light on the matter.

It is my firm belief that in keeping with POWER's policy of good judgment and only printing that which is in the best interest of its readers, another article should be published which would clarify the controversial nature of Mr. Edwards' piece.

W H BECKER, *Greensboro, N.C.*

EDITOR'S NOTE: *George Edwards reiterates that his sole intent was to point up the need for improved maintenance of this vital control. This need is substantiated by boiler insurance companies' records of losses from this cause each year.*

He has no quarrel with the thinking that advises installation of a second, separately piped, low-water cutoff where justified by circumstances.

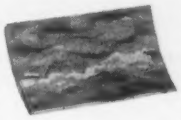
Concerning reader Becker's suggestion for a second "clarifying" article, Mr. Edwards feels that POWER *readers' views continuing to be expressed in these pages are an unbeatable substitute.*

. . . I think George Edwards put his finger squarely on a "thing" that is putting a big bulge in plant operating costs across the country. Congratulations to him for being so forthright.

He talks specifically about low-water cutoff maintenance, and while I agree with him wholeheartedly, I'd like to suggest that general indifference to even casual maintenance of other equipment is more widespread than we realize.

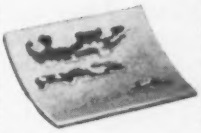
I'm enclosing a clipping which I hope you'll print. It's from the Hartford Steam Boiler Inspec-

With no lining at all



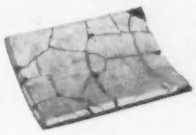
Unlined steel heaters are subject to corrosion even under normal service.

With plastic lining



There is no known plastic or phenolic lining that will withstand temperatures required for hot water service.

With ordinary concrete lining



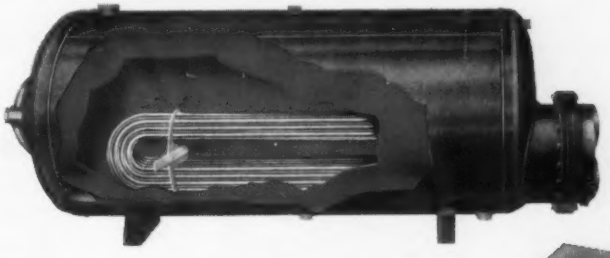
Plain steel plates soon lose protection, due to cracking and chipping. Cracks create localized corrosive cell spots.

SPECIFY the only cement lining made exclusively for Storage Water Heaters...

P-K PRE-KRETE®

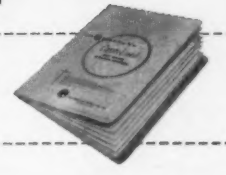
Every cement-lined storage water heater bearing the P-K name-plate is factory-lined with Pre-Krete. Pre-Krete is completely uniform, without weak spots or "holidays," because it is thoroughly blended in special P-K equipment. It forms a strong, durable coating, ¾" thick, that prevents rust and corrosion, and provides high resistance to thermal shock. Pre-Krete will not chip, crack, or flake even at temperatures up to 900°F.

You get a comprehensive guarantee on every P-K Storage Water Heater



Every P-K Pre-Krete Lined Storage Water Heater is fully lined including manhole, cover plate and heating element nozzle.

Specify P-K Pre-Krete lined and you get a storage water heater on which all materials and workmanship are fully guaranteed to be first-class in every respect, and you have the P-K assurance that every heater bearing its name will heat its rated capacity of water. For full details, write for your copy of Catalog Number 19 to Patterson-Kelley, 2507 Warren St., East Stroudsburg, Pennsylvania.



Patterson Kelley
Water Heater Division

storage water heaters • instantaneous heaters • convertors • water to water exchangers

For more facts circle 239 on Reader Service card, p 99

tion and Insurance Co's *Locomotive* and it's a perfect expression of just what I mean and what I think George Edwards must have had in mind.

"Statistically, a loss of the reader's boiler may be long past due if operating conditions are compared to operating conditions of such boilers as the one with which this article is concerned.

"The boiler was operating in the plant of the boiler manufacturer who built it. It was ruined when a condensate return pump failed to supply feedwater to the boiler. Firing continued after a low-water condition developed, although the boiler was equipped not only with adequate water-level controls, but with an outside agency remote alarm system—all of which failed. The boiler so overheated that all the tubes melted out.

"During the investigation the float chambers of the water-level controls were found to contain scale which apparently prevented their operation. Also, in testing the remote alarm system (which was intended to flash an alarm at the agency's headquarters if steam pressure exceeded 120 psi or dropped below 20 psi), the system was found to be inoperative. Reason for the latter failure has not been established positively, but investigators believe that the signal line had been accidentally disrupted by repairmen in the building.

"In light of this string of failures, it is not understood why the building did not catch fire to allow the sprinkler system also an opportunity to fail."

D PENDERGAST, *Baltimore, Maryland*

"Man, I've hit the promised land . . . who's in charge of buying around here?"

Leave no stone unturned

I want to congratulate George Edwards on his article giving tips on how to write for publication. ("You can make writing pay off," April, p 204). I can vouch for what he says because I have written pieces for POWER for a number of years.

His suggestions were excellent, but he left out a couple of items which I think are important. (1) When sending drawings with an article, I use different colored pencils. I've found that colors are helpful in conveying the idea. (2) If sending photos, mark "top" where it belongs.

G G AVANT, *Wilmington, North Carolina*

EDITOR'S NOTE: *There is no doubt about it, this helps make the writing man's article suit the editorial man's taste.*

On borrowed time

The reason that Mr Pender didn't blow himself up is that he had the devil's own luck. (*My biggest boner*, May, p 216). There is a very narrow range in which a flame will just burn if kept swinging about but the mixture is a little too rich to explode. This is a very difficult thing to demonstrate even in a laboratory, and that the condition existed throughout a tank is almost miraculous.

P D HOBSON, *Concord, California*

. . . the lantern flickering seems to indicate a mixture within the tank too rich to explode, with just enough oxygen to support ignition near the wick. Pender's most dangerous time was when the lantern was coming out through the manhole. Here, oxygen available could have (and should have) produced the right explosive mixture.

DAWSON POWELL, *Technical Editor Grinnell Co, Inc.*

You're not getting through

I do not agree with the solution to a *Plant Problem* entitled, "Make insulation resistance tests quickly" (May, p 213).

The test, as presented, shows nothing since the starter contacts are open. Therefore you would not be reading through to your motor windings. If it's assumed that the starter is blocked in a closed position, then make sure you lock and tag the main power supply to the main switch.

LOUIS R DIFILIPPO, *Area Engineer Savannah River Project, Aikin, S.C.*

EDITOR'S NOTE: *Mr DiFilippo is right. Simplest and safest way to make the test is at load terminals of starter, not by holding starter closed.*

Have you ever been troubled by any of these steam trap problems?

ARMSTRONG STEAM TRAPS are designed and made to eliminate these problems

BACK PRESSURE . . . Armstrong Traps operate on any back pressure—or vacuum, for that matter. As long as there is a pressure differential across the trap, it will close on steam and open for condensate. Even the high back pressure caused by blow through of one or more traps in the system will not disturb Armstrong Traps. Other than a reduction in capacity, Armstrong Traps are unaffected by back pressure.

DIRT . . . Armstrong Traps are not affected by ordinary dirt. When the trap opens condensate swirls down under the edge of the bucket and up through the discharge orifice. Dirt is kept in suspension and discharged along with the condensate. For very bad dirt conditions, Armstrong offers traps with integral strainers. These cost less than a trap plus a separate strainer.

AIR BINDING . . . Armstrong Traps cannot air bind. Air in the system passes through a vent in the top of the bucket. It collects in the top of the trap and is discharged with the condensate. There is no chance for it to stop the trap. For low pressure on-and-off units where large amounts of air accumulate while the steam is off, Armstrong offers open float and thermostatic air vent traps in a complete range of sizes.

WIRE DRAWING . . . Armstrong Traps are designed and made to resist wire drawing. The valve and seat are tough stainless steel. The valve opens and closes tightly with a fast action and is always water sealed. There is virtually no chance for grit or sediment to lodge in the valve, virtually no chance to create conditions that lead to wire drawing.

There's no need to accept any of these problems as "inevitable." Your local Armstrong Representative can show you how to end them all. Call him today or write direct.

860 Series for low pressure heating service.

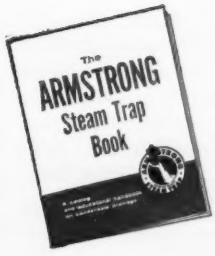
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

ARMSTRONG MACHINE WORKS

8121 Maple Street Three Rivers, Michigan

For more facts circle 240 on Reader Service card, p 99

Power's data sheet

No. 323

Piping insulation weights per linear foot—single layer

Pipe size, in.	1-in. thick			1½-in. thick			2-in. thick			2½-in thick			3-in. thick		
	Calcium silicate	85% magnesia	Diatomaceous earth	Calcium silicate	85% magnesia	Diatomaceous earth	Calcium silicate	85% magnesia	Diatomaceous earth	Calcium silicate	85% magnesia	Diatomaceous earth	Calcium silicate	85% magnesia	Diatomaceous earth
½	.447	.53	.977	.917	1.08	2.0	1.47	1.74	3.22	2.61	3.09	5.7	3.5	4.13	7.63
¾	.427	.503	.927	.887	1.05	1.94	1.44	1.71	3.15	2.59	3.06	5.63	3.47	4.1	7.6
1	.623	.737	1.36	1.1	1.3	2.4	1.76	2.08	3.83	2.54	3.01	5.57	3.43	4.07	7.5
1¼	.557	.66	1.22	1.34	1.59	2.93	1.7	2.01	3.7	2.49	2.94	5.43	3.37	3.97	7.33
1½	.727	.857	1.58	1.28	1.51	2.8	1.64	1.94	3.6	3.37	4.0	7.37	4.33	5.1	9.43
2	.857	1.01	1.87	1.52	1.79	3.31	2.3	2.72	5.0	3.25	3.83	7.1	4.17	4.93	9.13
2½	.997	1.18	2.18	2.14	2.53	4.67	3.09	3.63	6.73	4.03	4.77	8.8	5.13	6.07	11.2
3	1.13	1.32	2.43	1.9	2.24	4.13	2.84	3.37	6.2	3.73	4.43	8.17	4.83	5.73	10.57
3½	1.67	1.98	3.63	2.62	3.09	5.7	3.53	4.2	7.73	4.63	5.47	10.07	6.0	7.1	13.13
4	1.42	1.67	3.08	2.36	2.79	5.17	3.29	3.87	7.17	4.4	5.2	9.6	5.8	6.83	12.63
4½	2.05	2.42	4.47	2.97	3.5	6.47	4.1	4.87	8.97	5.43	6.40	11.83	6.83	8.06	14.87
5	1.69	1.99	3.67	2.61	3.09	5.7	3.73	4.43	8.17	5.13	6.07	11.2	6.47	7.63	14.07
6	1.83	2.16	4.0	2.93	3.46	6.4	4.33	5.1	9.43	5.63	6.67	12.33	7.1	8.40	15.53
7				3.43	4.03	7.49	4.77	5.63	10.4	6.23	7.37	13.6	8.3	9.8	18.07
8				3.8	4.5	8.33	5.2	6.17	11.37	7.27	8.57	15.83	9.03	10.67	19.67
9				4.1	4.87	8.97	6.16	7.27	13.43	7.93	9.37	17.27	9.77	11.53	212.7
10				4.77	5.63	10.4	6.53	7.7	14.23	8.37	9.87	18.23	10.5	12.4	22.87
11				5.13	6.07	11.2	7.03	8.33	15.37	9.17	10.83	20.0	11.2	13.27	24.47
12				5.43	6.4	11.83	7.63	9.0	16.6	9.77	11.53	21.27	11.97	14.13	26.07
14				5.588	6.604	12.192	7.755	9.165	16.92	9.889	11.687	21.576	12.243	14.469	26.712
15				5.940	7.020	12.960	8.151	9.633	17.784	10.945	12.935	23.880	12.958	15.314	28.272
16				6.292	7.336	13.728	8.635	10.205	18.84	11.099	13.117	24.216	13.684	16.172	29.856
17				6.644	7.852	14.496	9.199	10.777	19.896	11.704	13.832	25.536	14.399	17.017	31.416
18				7.029	8.307	15.336	9.592	11.336	20.928	12.298	14.534	26.832	15.114	17.862	32.976
19				7.381	8.723	16.104	9.438	11.154	20.592	12.903	15.249	28.152	15.840	18.720	34.56
20				7.744	9.152	16.896	10.549	12.467	23.016	13.497	15.951	29.448	16.555	19.565	37.704
21				8.096	9.568	17.664	11.033	13.039	24.072	14.102	16.666	30.768	17.281	20.423	37.704
22				8.459	9.997	18.456	11.528	13.624	25.152	14.696	17.368	32.064	17.996	21.268	39.264
23				8.822	10.426	19.248	12.001	14.183	26.184	15.301	18.083	33.384	18.722	22.126	40.848
24				9.185	10.855	20.040	12.474	14.642	27.216	15.895	18.785	34.680	19.437	22.971	42.408
25				9.537	11.271	20.808	12.958	15.314	28.272	16.489	19.487	35.976	20.163	23.829	43.992
26				9.889	11.687	21.576	13.442	15.886	29.328	17.094	20.202	37.296	20.878	24.674	45.552
27				10.714	12.662	23.376	13.915	16.445	30.360	17.699	20.917	38.616	21.593	25.519	47.112
28				10.615	12.545	23.160	14.399	17.017	31.416	18.238	21.554	39.792	22.319	26.337	48.696
29				10.978	12.974	23.952	14.883	17.859	32.472	18.898	22.334	41.232	23.034	27.222	50.256
30				11.33	13.39	24.720	15.356	18.048	33.504	19.503	23.049	42.552	23.76	28.080	51.840

Sources: The Magnesia Insulation Manufacturer's Association Manual—Second Edition
Johns-Manville Data Sheets

Calcium silicate—density 11 lb per cu ft
85% magnesia —density 13 lb per cu ft
Diatomaceous earth —density 24 lb per cu ft

Insulation weight affects hanger loads

Table compares weights of three commonly used materials as single layer insulation. Weight variations show the importance of determining insulation type before calculating piping hanger loads. Figures are for Johns-Manville materials, but weights for equivalent products by other manufacturers are approximately the same.

GEORGE C HALZELL, *Boston, Mass.*

© POWER

News and Notes on...

Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

Subject of the month: Trouble-shooting Packing Problems

Question:

How can you pinpoint the cause of a premature failure?

If you carefully examine used packing, a correct interpretation of the damage will often suggest exactly what caused a premature failure.

Generally speaking, the reasons fall into three areas: (a) the wrong size or style packing was selected for the particular service conditions, (b) the packing was not properly installed, or (c) the equipment requires maintenance. And any of these three conditions can not only result in premature packing failure . . . but can lead to other headaches resulting from poor performance of equipment.

Let us review some of the most common types of packing failures and their causes . . . easy to recognize through a careful inspection of the damaged packing.

1. ***Damage:*** Excessive reductions in the cross-section of the packing.

Possible cause: Bearing worn, or other shaft misalignment result in eccentric movement such as shaft "whip."

2. ***Damage:*** Wearing face of the rings dried and charred, but the rest of the packing is still in good condition.

Possible Cause: Either lack of proper lubrication, or the packing was not designed to withstand speed of movement involved, or the temperature range of service encountered.

J-M #7 Centripac® Packing shown here is designed specifically for single-stage centrifugal pumps in the process industries. Speeds to 3600 rpm; temperature to 500F.

3. ***Damage:*** One or more rings missing from set.

Possible Cause: Bottom of the stuffing box is badly worn, and allows the packing to extrude into the system, causing possible contamination.

4. ***Damage:*** Wear on outside diameter of the packing.

Possible Cause: Rings rotating with the shaft, or coming loose in the box. Choosing the correct size of packing will eliminate this problem.

To solve any sealing problem, call on your local J-M Packing Distributor or Johns-Manville representative. They are equipped to help you select the right packing for the job—one that insures long, trouble-free service. For information, write to Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

For more facts circle 241 on Reader Service card, p 99

Circle 242 on Reader Service card, for Following Ad ➤

YOUR BEST BUY

General Electric Master Unit Substations are your best "total value" buy—most advanced transformer, switchgear designs . . . completely integrated for modern, economical power distribution.

For a "total value" product appraisal, consider these over-all advantages of factory-built unit substations, then factor in the product superiority of G-E transformer and switchgear components.

With factory-built substations, you benefit from the work of G-E's expert engineering staff which takes over the detail jobs of substation design and frees your engineers for other projects.

Centralizing responsibility with General Electric assures you of a thoroughly integrated, modern product, like the unit substation shown at the right which supplies the entire electrical load for the new United States Gypsum Company plant at Galena Park, Texas. Single billing against one order number means simplified cost control. Coordinated shipment results in quicker, less-costly installation. Factory-built unit substations make possible a building-block approach to low-cost expansion.

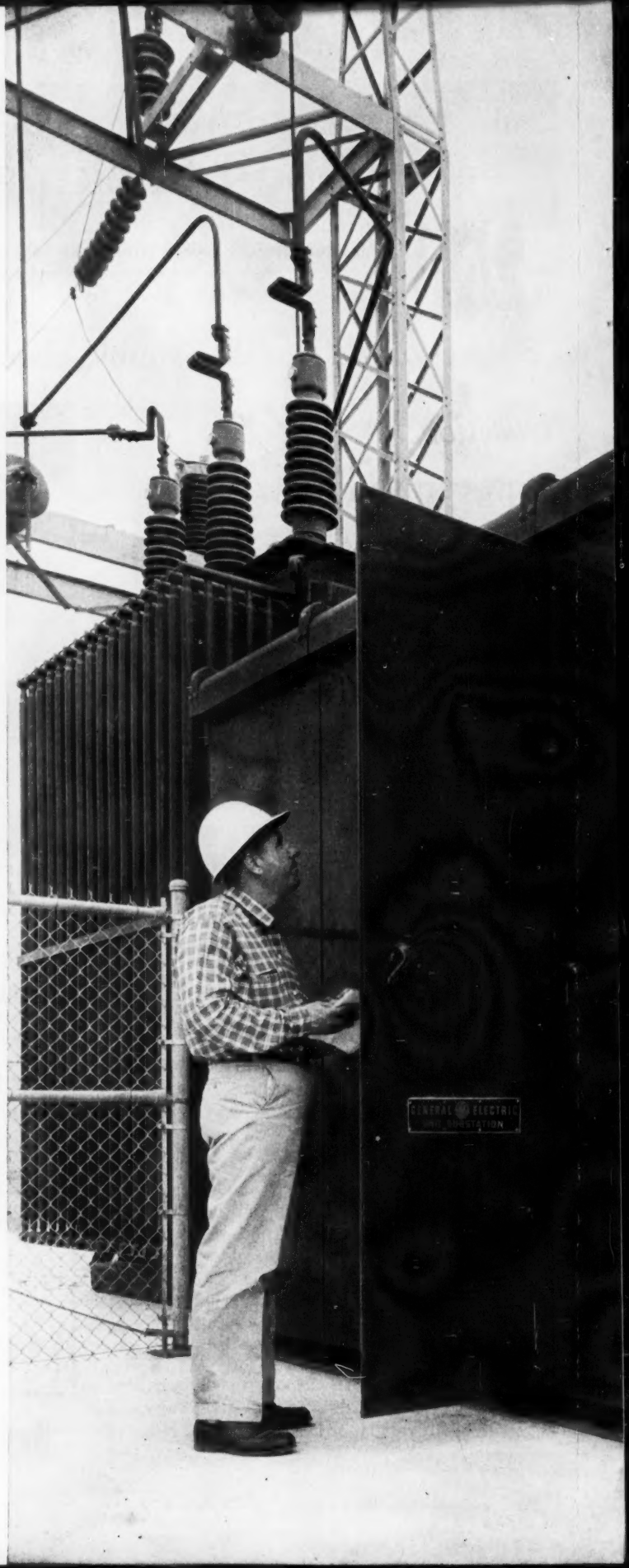
Unit substations have been accepted as community "good neighbors" because they are attractive, compact, easy to landscape, and have low noise levels.

After you make the basic determinations of station arrangement, subtransmission and feeder voltages, specify a General Electric Master Unit Substation for the best "total value" buy for your distribution system investment. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y.

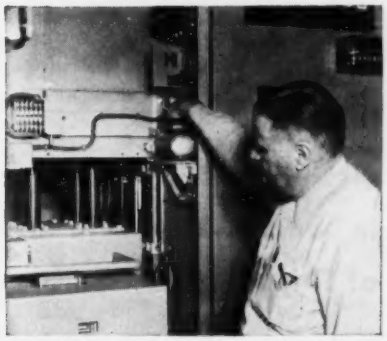
512-32

Progress Is Our Most Important Product

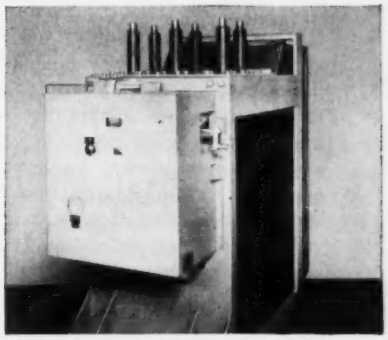
GENERAL ELECTRIC



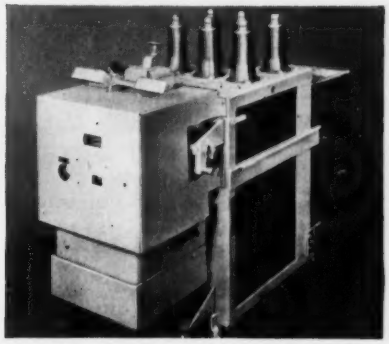
These switchgear features are part of G-E Unit Substation value



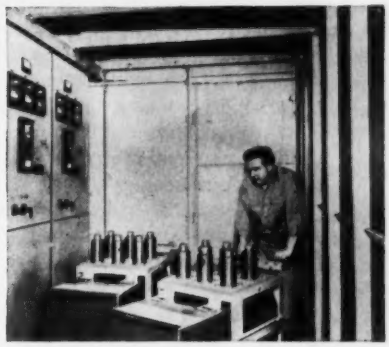
VERTICAL-LIFT DESIGN makes inspection, maintenance safer. Operators can actually see when primary disconnects are parted.



FIRST 1000 MVA BREAKER was developed to meet need for increased interrupting capacity. It makes G-E line most complete in industry.



TWO-CYCLE BREAKER offers benefit of reduced line burning during fault, better coordination with other distribution protective devices.



PROTECTED AISLE permits maintenance—indoors—in any kind of weather. An optional feature, the protected aisle is shipped factory-assembled.

Technical briefs . . . Latest engineering

Flexibility is keynote in radioactive-waste disposal at Shippingport reactor

Evaluation of the initial performance of the Shippingport radioactive-waste disposal plant, *J R LePointe and W J Hahn, Westinghouse Electric Corp; E D Harwood, US Public Health Service*

Radioactive-waste disposal facilities at Shippingport were conservatively designed to provide flexibility in handling waste materials. System is sized to take care of waste from the first PWR core and is even large enough to handle reactor cores not yet designed or envisioned. Large size permits reactor operation with low-quality fuel elements or with various casualty conditions present.

To handle radioactive-liquid wastes an ion exchanger takes care of nonvolatile fission products and a gas stripper removes the microscopic amounts of volatile fission products. Gaseous products are treated in flash tanks, then by other equipment. Solid waste is burned and residual ash, if contaminated, is mixed with concrete and buried at sea.

So far discharge of radioactive liquids and gases to the environment has been at a level much below the state's maximum allowable discharge. They learned an important lesson: a system must be flexible enough to handle high-quantity low-activity wastes as well as low-quantity high-activity wastes without restricting operation. This is particularly true if the plant is operated at times as a central station and at other times as a peaking plant. *NESC Preprint V-1*

Acceptance testing of nuclear-power plants, *W H Hamilton and G H Conley, Westinghouse Electric Corp*

Testing out a nuclear plant requires mechanical equipment engineers, physicists, chemists, electrical and instrument and fluids-system engineers, heat-balance and thermal analysts and plant-construction engineers. Then there is representation from the construction company, the plant designer, the operators, component manufacturers and AEC. Coordinating activities of all these parties rests with the test engineers.

Once the initial hydrostatic test is complete any subsequent tests are run at 110% of design. Performing all hydrostatic tests at initial 150% of design might work-harden the materials. One precaution observed is to maintain primary-coolant pressures above secondary pressures to avoid the risk of creating crevices in the tube-to-tube-sheet joints on the secondary side of the steam generators.

Following hydrostatic test is the cold-system performance of auxiliary piping in the fluid systems, then filtering overall system, hot operation, core insertion and initial core fill. Next comes a series of core tests: initial tests of rod control, physics tests, flow coastdown, low- and high-power operation, transient and extended power operation. Paper describes each test phase and the planning behind it. *NESC Preprint 62.*

Water treatment

Handling and feeding acid to demineralizers, *T P Harding, Omaha Public Power District*

Sulfuric acid regenerates demineralizer cation resins. Normally the acid isn't difficult to work with, but safe handling and storage present unique problems.

When working up a sulfuric-acid-handling system, assume every piece of equipment exposed to the acid will fail sooner or later. With this in mind keep the system simple. Displacing acid in either trucks or railroad tank cars with air is one unloading method. If you use air be sure compressor serves only this system, or pressure higher in tank than in air lines could force acid into air system.

Drop air line down to within six inches of tank bottom. Bubbling air through caustic dries air, cutting corrosion problems inside tank. Fabricate caustic line between unloading station and storage tanks and air line into unloading car so they are easily replaced. Paint storage tanks with aluminum; temperature difference between aluminum and light-gray tanks can be enough to start corrosion.

Pressurized systems will do the job, but a submerged sump pump will be just as good and cause less worry.

Reduction of metal-contact area is more important than acid velocity so use lines as small as possible of schedule 160 pipe to carry acid from storage to demineralizers. Erect these lines so you can get at them and place a second line over any area where a leak might spray personnel. *Engineers' Society of Western Pennsylvania*

Handling and feeding chemical solutions to clarifying and softening equipment, *J E Stary, National Aluminate Corp*

Liquid-feed equipment is preferred over dry feeders if one or more of the following conditions is present: (1) chemical feed is relatively small (2) chemical to be fed is sticky, moist or gummy (3) two or more chemicals can be mixed and fed from the same feeder arrangement (4) liquid chemicals are used.

Once liquid-feed system is chosen, preparation of solution becomes important: incomplete chemical dissolving results in inaccurate dosages and often in plugged feedlines and pumps, worn pump pack-

ing and impellers. Complexity of equipment will be governed by how closely you must hold the water treated to some foreign-matter level.

After detailing the various types of feeders available, author discusses feeding problems sometimes present in system due to mixing and chemical troubles. *Engineers' Society of Western Pennsylvania*

Handling and feeding dry chemicals to clarifying and softening equipment, *J F Wilkes, Dearborn Chemical Company*

Dry-feed chemical equipment generally pays biggest dividends in large water-treatment plants where chemical volume handled is also large. Main advantage is space saving: if treatment uses large amounts of chemicals, dry-feed system might take only 10% of the room a liquid layout needs.

Two basic types of dry-feed equipment are volumetric and gravimetric. Volumetric type is used when: (1) feed-rate variations of 3 to 5% are allowable and (2) accurate recording or totalizing of chemical weight discharged is not essential. Gravimetric systems provide feed rates with automatic control and accurate recording.

Volumetric feeders measure only volume displaced and not material weight. They usually need close attention from plant operators to insure continuous operation at acceptable efficiency. They're used in small plants where operation rate is constant, equipment operation checks can be made and retention capacity of mixing and settling basins is large enough to offset variations in density and feeding.

Gravimetric feeders are preferred since they fit into automatic control systems. Guaranteed accuracy is within 1%. Author illustrates different types of both volumetric and gravimetric equipment and shows where each is best used. He then discusses control methods, chemicals to be fed, operating and maintenance problems and selection of feeder equipment. *Engineers' Society of Western Pennsylvania*

Handling and feeding caustic soda to demineralizers, *I S St. John, E I du Pont de Nemours and Co*

Liquid caustic soda is used for the regeneration of anion-exchange resin in the demineralization of water. Quantities used in this plant permit tank-car delivery of 8000 to 10,000 gallons per car. In addition to standard safety equipment—rubber clothing, deluge showers—additional devices used in transfer work keep chemical contact to a minimum.

Transfer pump for car unloading is primed with an air ejector. This eliminates spraying caustic that might result from pressurizing car and pump with air. After eductor is turned on and air-caustic mixture discharge appears, eductor is closed and pump-discharge valve slowly opened. At this point pump is primed and caustic flows until car is emptied. During cold weather steam is used to keep caustic above its freezing point of 56 F.

Tank trucks are used to service smaller use areas in plant. Each truck has a submerged unloading pump permanently installed. Tank holds 2500 gal.

Mild steel and black iron were used for all piping and storage materials except for the horizontal U-tube steam heater in the storage tanks. Nickel was used here since the thin-walled mild-steel heater developed localized high temperatures. Control of cold-weather heating is critical since temperatures over 100 F accelerate corrosive action of 50% caustic on mild steel.

Demineralization units of two different sizes have flow rates of 550 and 140 gpm at this plant. Each unit is fed 2.5% caustic solution at 100 F through perforated polyvinyl-chloride headers for 75 minutes for regeneration of anions. Details of feed system are given in paper. *Engineers' Society of Western Pennsylvania*

Standards

Butt-welding ends; *for pipe, valves, flanges and fittings*

Preparation of butt-welding ends of pipe, valves, welding neck flanges and pipe fittings are covered. Standard also applies to other piping components which are connected into the system by butt welding.

It includes requirements for re-entrant shapes for heavy wall ends, welding bevel profiles, inside contours for joints made with or without backing rings, and machining dimensions with their tolerances. *ASA B16.25-1958*

Twist drills; *straight shank and taper shank, combined drills and countersinks*

In the first revision of this standard since 1950, changes include: (1) addition of combined drills and countersinks (2) addition of selected sizes of millimeter drills (3) addition of screw-machine-length drills (4) changes in names of drills for sake of clarification (5) deletion of the automotive-drill series (6) addition of an appendix listing drills by decimal size and (7) nomenclature clarification. *ASA B5.12-1958*

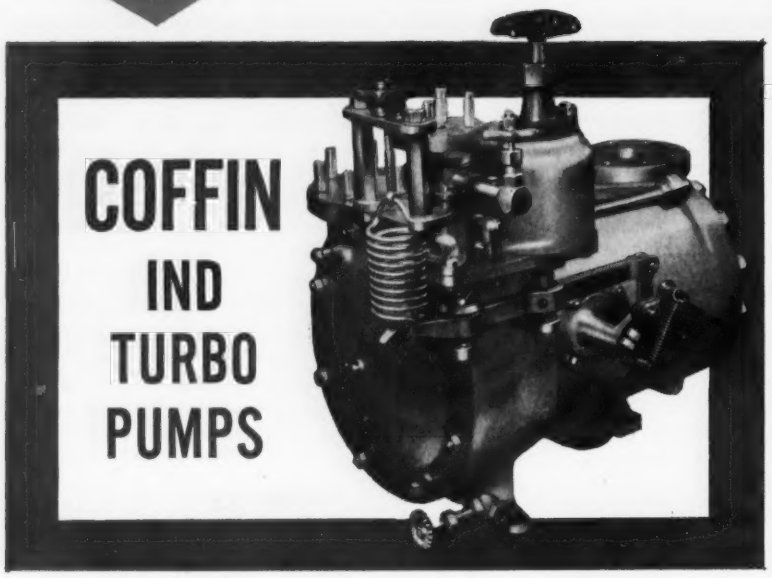
Lock washers

Main changes in the revised standard are: (1) 1⅝- to 3-inch sizes have been added to the light and heavy spring-washer series (2) tolerance on nominal thickness of spring washers has been added (3) specifications for hardened screw-and-lock washer assemblies have been included. A few minor revisions and corrections have also been made in text of this 1944 standard. *ASA B27.1-1958*

Directions for ordering these papers on page 94

continued

Complete Pump, Turbine and Controls



PACKAGED — integral design of the IND Pump results in a compact, highly efficient unit which mounts impeller and turbine wheel on a short, rigid shaft. The unit is equipped with complete controls for constant or differential pressure regulation.

APPLICATIONS — compact and highly efficient, the Coffin type IND Steam Turbo Pump is designed for General Boiler Feed or any other pumping service where medium volume and high pressure is required.

SPECIFICATIONS-

Capacities	to 180 GPM —	Height 32"
Discharge Pressures	to 350 PSIG —	Width 25"
Liquid Temperatures	to 300°F —	Length 32"

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Technical briefs

Begins on page 88

Gas turbines

40,000-kw gas-turbine power plant — Mayaguez, Puerto Rico, *Z S Stys, Brown Boveri Corporation*
Gas turbines are becoming firmly established as peaking units in rapidly growing and isolated power systems; two areas that bear out this claim are Canada and Puerto Rico. Installations of 60,000 kw and 120,000 kw are scheduled for Edmonton and Vancouver, Canada, and 40,000 kw in Mayaguez, Puerto Rico.

The addition in Mayaguez will consist of two 20,000-kw units, one of which was scheduled to go on-line in January, 1959, the other in May, 1959. This increase will boost the total generation capacity of the plant to 49,000 kw, the other 9000 kw coming from old steam units. The gas-turbine units will be double-shaft nonregenerative cycle with interstage cooling, designed to burn bunker C oil. Since the generator may be used as a synchronous condenser it is oversized—rated at 32,500 kva, 13.8 kv, 60 cycles—and will have an uncoupling device so that once it's on line it can float there with the turbine disconnected.

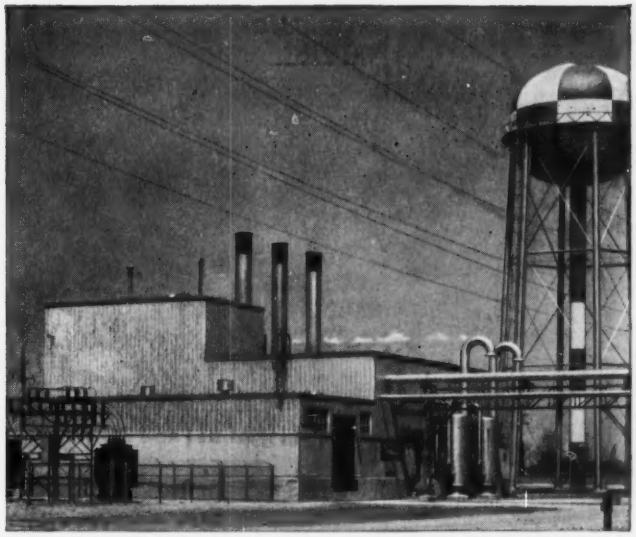
Before starting fuel heating is handled by a small light-fuel-fired boiler. This cuts out once starting speeds are reached and a waste heat boiler takes over. *ASME paper 59-GTP-11*

Miscellaneous

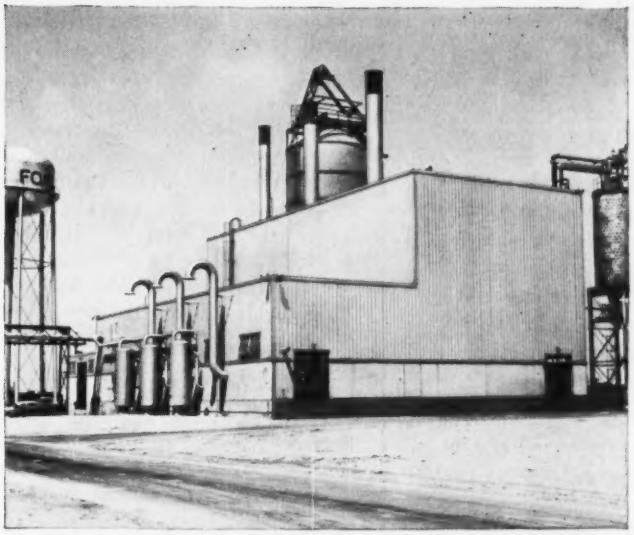
Operating experience in the Illinois-Missouri power pool, *E A Schultz and T W Schroeder, Illinois Power Co*
Three midwestern utilities, the Central Illinois Public Service Co, Illinois Power Co and Union Electric Co of Missouri placed their combined power resources—whether self-generated or purchased — in a common pool in September 1952. Member companies retained complete control over their property yet were bound by a pact to cooperate fully with other members for the benefit of the pool. So far the pool has enabled the participating companies to avoid power shortages in the area they serve. Also there has

Directions for ordering papers on page 94

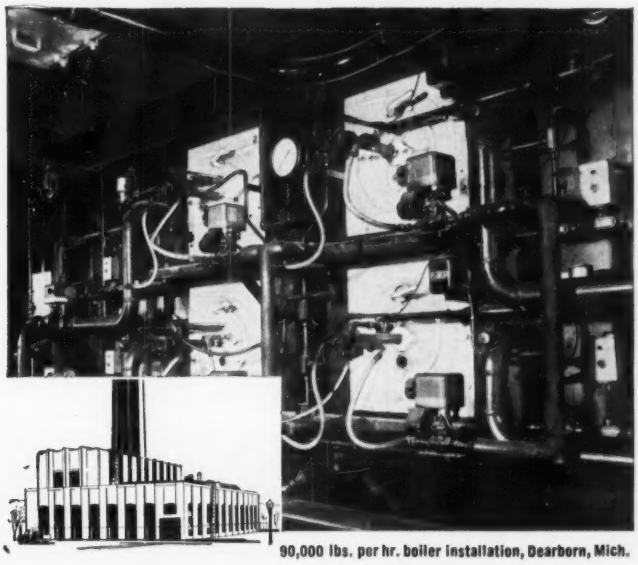
For more facts circle 243 on Reader Service card, p 99



Steam and compressed air plant, Rawsonville, Michigan. Total capacity: 120,000 lbs. per hr.



Steam and compressed air plant, Indianapolis. Total capacity: 300,000 lbs. per hr.



90,000 lbs. per hr. boiler installation, Dearborn, Mich.

FORD POWERS UP with Pritchard-built power plants

What's the most important factor in an industrial power plant? Efficiency? Low investment cost?

The Ford Motor Co. will tell you it's neither factor—when considered separately. The highly efficient plant may have cost so much to build that its products—steam and air—are too expensive for the highly competitive automobile manufacturing business. On the other hand, the low cost plant may never operate efficiently and may be subject to frequent break-downs.

The first power plant built for Ford by J. F. Pritchard & Co. has shown a favorable operating cost-investment cost ratio. Since then, two more Ford power construction jobs have been completed by Pritchard.

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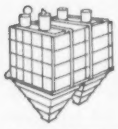

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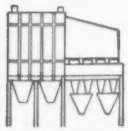

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Technical briefs

Begins on page 88

been no reduced voltage or shed load.

Two greatest benefits to pool members are a large reduction in the cost of reserves and ability to get the economical benefits from large generating units not justified by the total load on individual members.

Paper presents main details of pool agreement and concepts that have enabled it to work well so far. *AIEE paper CP-58-1114*

Influence of hot and cold storage loads on the refrigerated-space temperature of a cooling complex, *C F Kayan, Columbia University, New York*

Warm goods brought into an empty refrigerated space present a transient cooling problem; if the space is partially filled with goods that are at the same temperatures as the space and more goods are brought in, that is a second problem. Structure wall adds to the complexity of predicting new heat-flow rates and heat-exchanger performance; it must be considered as having real heat capacity compared with one with negligible capacity. Analog simulation with pilot-plant techniques proves a worthwhile solution method.

An example broken into two parts and dealing with each of these problems is illustrated with complete design data and the equivalent electrical representations for solution procedures. *ASME paper 58-A-165*

Relative thermal performance of carbon dioxide and helium in nuclear-power cycles, *F E Tippets, General Electric Company, Atomic Power Equipment Department*

Carbon dioxide, nitrogen, helium—one of these is the most likely choice for best heat-transfer and thermodynamic working fluid in nuclear-power gas-turbine and nuclear-power steam-turbine cycles. An analytical comparison of the heat-transfer characteristics and thermal performance of carbon dioxide and helium in typical nuclear-power cycles produced these results:

(1) In the nuclear power-gas turbine cycle, CO_2 as a coolant will need

Directions for ordering papers on page 94.

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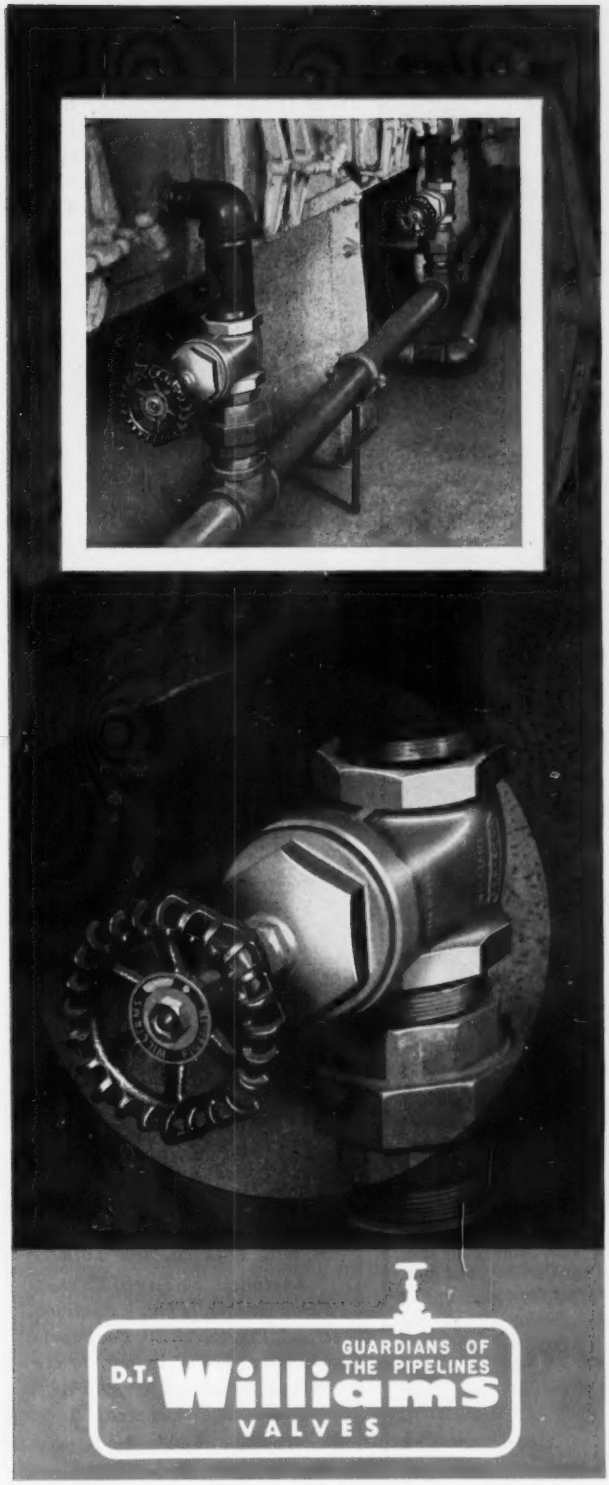

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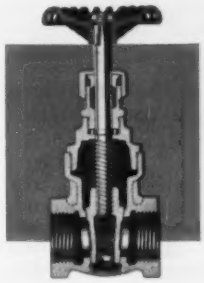
D. T. WILLIAMS VALVES
at Jones-Dabney Co., Division of
Devoe & Raynolds Co., Inc.

Handling a hazardous liquid like paint thinner is a tricky job at best. Safety control measures are vital. Here are two of the many dependable Williams gate valves used in a large installation just completed for Jones-Dabney Co., Detroit, Michigan, by the Diebold Service Co. The piping shown carries the flow of thinner from storage tanks on the first floor to paint mixing vats on the floor above. Other Williams valves are used at the pump station and on other lines in the plant. Do you have a similar important job?



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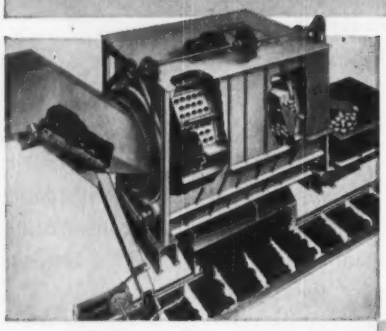
Rugged Cost Cutting Coal Processing Equipment

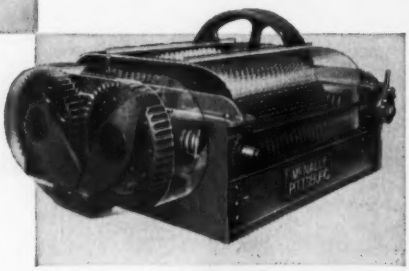


McNally Pittsburg Rotary Breaker

This heavy-duty unit allows positive control of top size in handling run-of-mine washery feed. Production of fines is held to a minimum. Without center shaft or spoke interference, costly maintenance is usually drastically reduced.

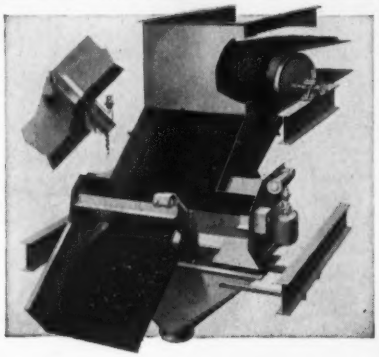
Gearmatic Stoker Coal Crusher

Built to handle heavy coal tonnages, these crushers have proved most efficient to reduce 8″ minus to stoker grades. They offer three major advantages: 1) high volume production; 2) accurate sizing; 3) low percentage of fines.



McNally Pittsburg Primary Coal Sampler

This automatic sampler (adjustable from 1 to 30 minutes) cuts out true samples of the coal stream. Cutter opening permits largest particle of stream to pass freely into cutter. Conveyor discharges into chute in which sampler is installed.



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Technical briefs

Begins on page 88

from 1.5 to 6.0 times the heat-exchanger surface area helium takes, depending on the part of the cycle.

(2) Nuclear power-steam turbine cycle isn't as clear-cut. Initial calculations favor the helium coolant (CO_2 will need 1.3 to 2.3 times the surface area of helium) but this is with standard construction. If "finer" CO_2 surfaces are used the reactor thermal rating can be upped 40% with CO_2 relative to He for the same compressor work per unit of heat transfer. And if power level is fixed, a CO_2 system will need only about 60% of compressor work for He.

(3) Reactor heat-transfer area need for the gas-turbine cycle is up to 35% greater than that needed for the steam-turbine cycle.

(4) Gas-turbine cycle efficiency will range from 30 to 35% regardless of whether CO_2 or He is the coolant. This range also holds for the steam turbine-nuclear power cycle. All comparisons are made assuming equal pressure, temperature and output levels and efficiencies. *ASME paper 59-GTP-14*

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Material for these abstracts comes from the following sources. Order complete paper from the source, not POWER.

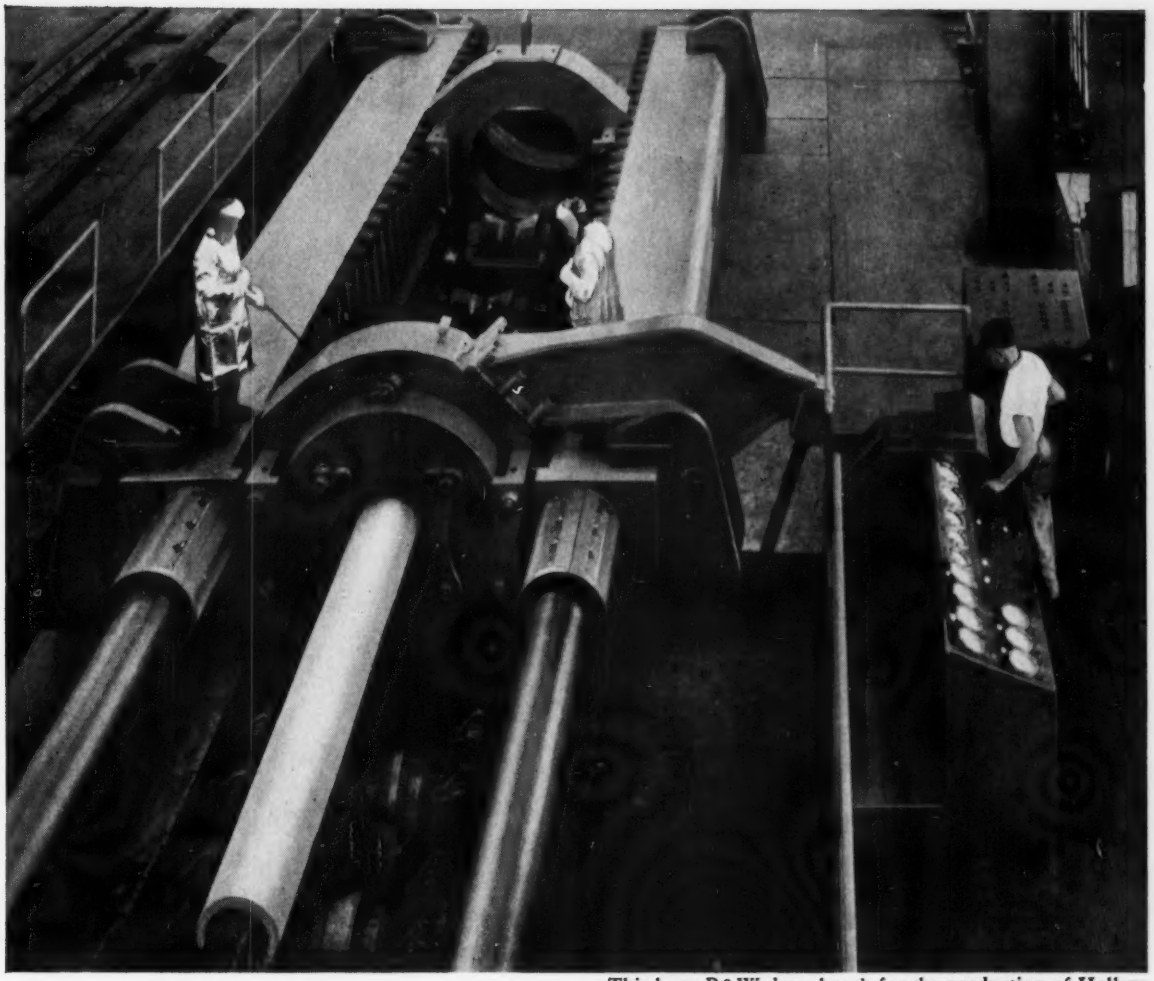
American Society of Mechanical Engineers (ASME). Obtainable through ASME, 29 W 39th St, New York 18, N. Y.

American Institute of Electrical Engineers (AIEE). Obtainable from AIEE, 33 W 39th St, New York 18, New York.

Engineers' Society of Western Pennsylvania, Penn - Sheraton Hotel, Pittsburgh 30, Pa. Papers will be available as part of the Proceedings *of the 19th Annual Water Conference.*

American Standards Association (ASA). Order Standards *from ASME.*

Nuclear Engineering Science Conference (NESC). Papers available from Engineers' Joint Council, 29 W 39th St, New York 36, New York.



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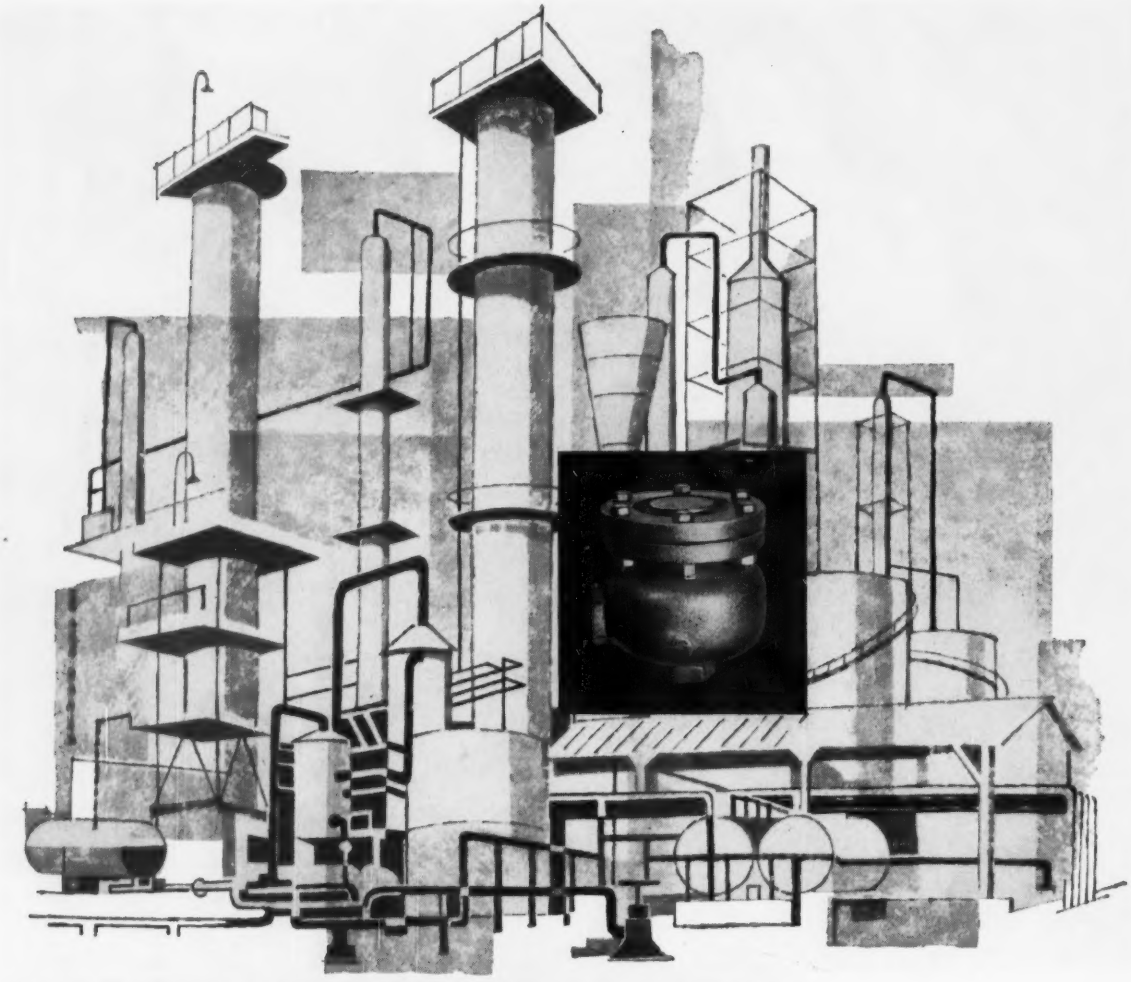

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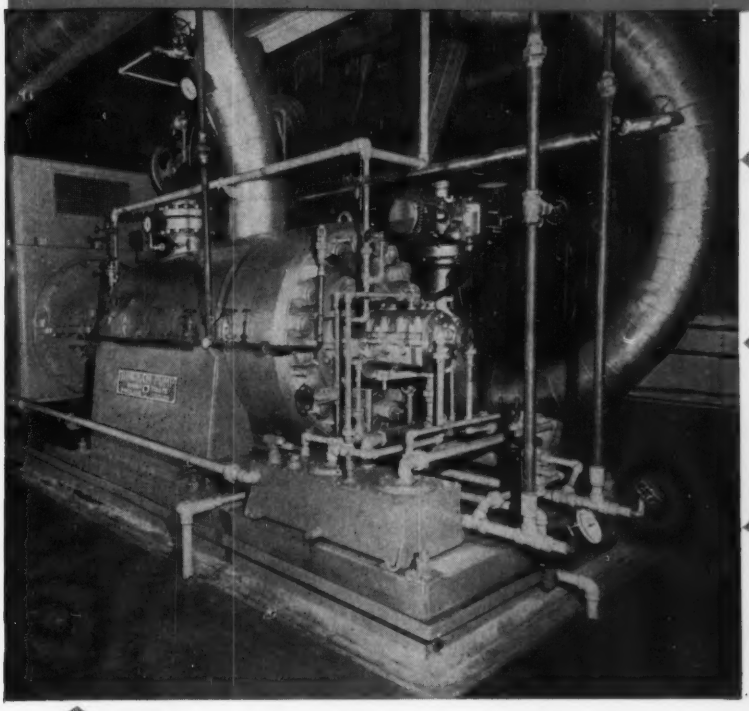

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MATERIALS

107 **Galvanized steel sheets** are topic of 36-p booklet. Properties, industrial applications, purchase and maintenance are discussed, comprehensive specs included. American Zinc Institute, Inc

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110 **Cadmium**, lead and tin products are described in 4-p folder. Available sizes are detailed. White Metal Rolling and Stamping Corp

COMPRESSORS AND ACCESSORIES

111 **Portable rotary compressor**, 125-cfm model, is discussed in 4-p folder 2930. Photos detail features. Ingersoll-Rand Company.

112 **Afterdryer system** for compressed air is topic of technical bulletin. Wilkerson Corporation

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113 **Coal preparation** and handling equipment is described in 128-p manual 559. Book includes photos, dimensional drawings and capacities, plus essential engineering data and reference tables. The McNally Pittsburg Mfg Corp

114 **Vibrating screens**, 12 types in 212 sizes, are covered in 48-p booklet 2777. Screen cloths, accessories are described and illustrated. Tables list materials, selection data. Link-Belt Co

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122 **Installation** of preformed splices on messenger strands, guy strands, ground wires is discussed in pocket-sized booklet 85-300. Preformed Line Products Company

123 **Thermosetting** electrical tapes are outlined in 4-p booklet E-PTAF. Properties table lists 15 tapes. Minnesota Mining and Manufacturing Co

124 **Upper temperature limits** of electrical tapes are covered in 6-p folder E-PETF. Bar graph shows relative life spans. Minnesota Mining and Manufacturing Co

125 **Controllers** for squirrel-cage motors are subject of 4-p bulletin 14B8750. Photos, diagrams are included. Allis-Chalmers Manufacturing Company

126 **Modular storage batteries** are subject of brochure I-1. Various arrangements of three standard types are shown. Scranton Cellomatic Battery Corp

127 **Oil-immersed contactor** is described in 4-p bulletin 14B8752. Includes photos, diagrams of the unmounted ac unit. Allis-Chalmers Manufacturing Company

128 **Phase-sequence indicators** are topic of 2-p catalog sheet 1551. Opad Electric Company

INSTRUMENTATION

129 **Instrument and control panels** are detailed in 16-p booklet G71-7. Standard procedures for tubing and wiring are given. Bailey Meter Company

130 **Packaged** automatic control panels for gas-engine-driven compressors are described in 10-p bulletin 170. Includes application photos. Clark Bros Co

continued

July 1959 issue

This card void after October 1, 1959

Circle key numbers below for FREE information on...

PLANT EQUIPMENT in the news this month, starting on p 110

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51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NEW LITERATURE listed in this issue, starting on p 100

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ADVERTISED PRODUCTS appearing throughout the issue

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NEW FREE LITERATURE continued..... circle key numbers, page 99, for your copies

131 **Gas-flow control** equipment for argon, helium and CO_2 is topic of 12-p catalog 806 A. Describes operation, applications. Air Reduction Sales Company

132 **Water-treatment plant** control is discussed in 8-p bulletin W18.1-2. Problems faced by utility, methods of solving them are covered. Bailey Meter Company

133 **Ring balance meters** are covered in 8-p bulletin MSP-160. Applications are discussed, illustrated. Hagan Chemicals & Controls, Inc

134 **Meter-relays** and how and why they work are topics of 4-p bulletin S-1. Assembly Products, Inc

135 **Solid-front gages** are described in 4-p catalog 500SF. Includes construction details, specs. Crosby Valve & Gage Company

136 **Resistance elements** for temperatures to 1200 F, pressures to 4500 psig are described, illustrated in 4-p bulletin E51-6. Bailey Meter Company

137 **Steam-pressure regulator** is topic of bulletin E 102A. Unit is a complete automatic combustion-control system for packaged boilers. Reliance Instrument Manufacturing Corp

138 **Flow-rate calibrator** is designed for checking rotameters. Spec sheet SS-903 gives details. Brooks Rotameter Company

139 **Smoke-density indicator** and alarm is topic of bulletin E 103A. Reliance Instrument Manufacturing Corp

140 **Alarm-controls** to guard against smoke in air-conditioning system are described in bulletin 553. Photomation, Inc

141 **Nonfrosting** liquid-level gages are topic of data sheet 351. Jerguson Gage & Valve Company

142 **Sight flow indicators** and drip sight feeder are covered in data sheet 350. Jerguson Gage & Valve Company

LUBRICATION

143 **Lube selector** chart for extreme-pressure jobs is included in 4-p bulletin 121. The Alpha-Molykote Corporation

144 **Oil selection** and maintenance for roller and silent chain drives is covered in 4-p bulletin 54. Includes charts. Sun Oil Company

MAINTENANCE

145 **Wire ropes** are topic of 4-p bulletin 107. Book shows how to match rope to job. H K Porter Co, Inc, Leschen Wire Rope Div

146 **Masking tape's** industrial applications are illustrated in 8-p booklet P-MTAFR. Minnesota Mining and Manufacturing Co

147 **Open flooring** for industrial applications is described and illustrated in 24-p booklet 2527-R. Types, surfaces are covered. Blaw-Knox Co, Grating Dept

148 **Wire-rope fatigue prevention** is topic of bulletin 105. H K Porter Company, Inc, Leschen Wire Rope Div

149 **Ultrasonics** and its uses is topic of 5-p reprint. Acoustica Associates, Inc

150 **Acid-resistant cement** selection is topic of bulletin 5-2. Atlas Mineral Products Company

151 **Engine-filter maintenance** is topic of illustrated folder. Engine Life Products Corp

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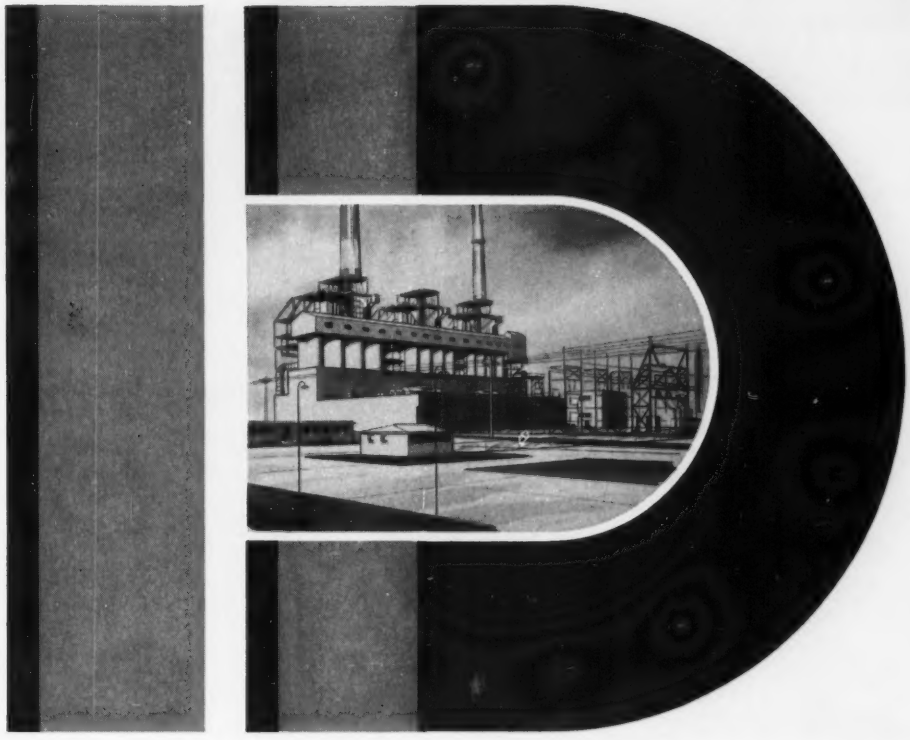

Little Gypsy - - - first computer controlled electric power plant!

The electric power industry took a giant step toward safer and more efficient plant operation with the announcement that the new 230,000 kw Little Gypsy Station of Louisiana Power & Light Company will be completely automatically controlled by a Daystrom digital computer control system.

The decision to go ahead with this project was backed by a year's operational experience with a Daystrom computer operating on-line at LP&L's Sterlington Steam Electric Station.

The original Sterlington installation, delivered over a year ago, came about through the combined engineering efforts of Louisiana Power & Light Company, Ebasco Services Inc., design and consulting engineers for LP&L, and Daystrom Systems.

The Sterlington computer system performance has demonstrated for the first time the reliability and utility essential to the stringent requirements of overall control responsibility. This field operating experience permits Daystrom to guarantee system operational availability of more than 99%. The uncompromising criterion of design which makes this performance possible dictates the complete elimination of vacuum tubes and moving parts.

The Little Gypsy computer system will perform the following functions: (1) Control sequentially the 800 or more steps necessary for plant start-up and shut-down, continuously checking the overall progress of the operation; (2) Monitor at the rate of ten times per second the hundreds of electrical signals signifying plant operating conditions and safety; (3) Instantly recognize abnormal conditions and take appropriate corrective action automatically; (4) Control combustion, feed water and steam temperature for best efficiency.

A substantial number of these systems have already been purchased for performance data reduction and automatic control. The availability of these new techniques and associated equipment warrant your careful study. For conference arrangements write or telephone Daystrom Systems, A-111, Miramar Road, La Jolla, California. GLencourt 4-0421.

INPUT CONSOLE – STERLINGTON COMPUTER.

DAYSTROM SYSTEMS
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Reliable computer control systems

For more facts circle 252 on Reader Service card, p 99

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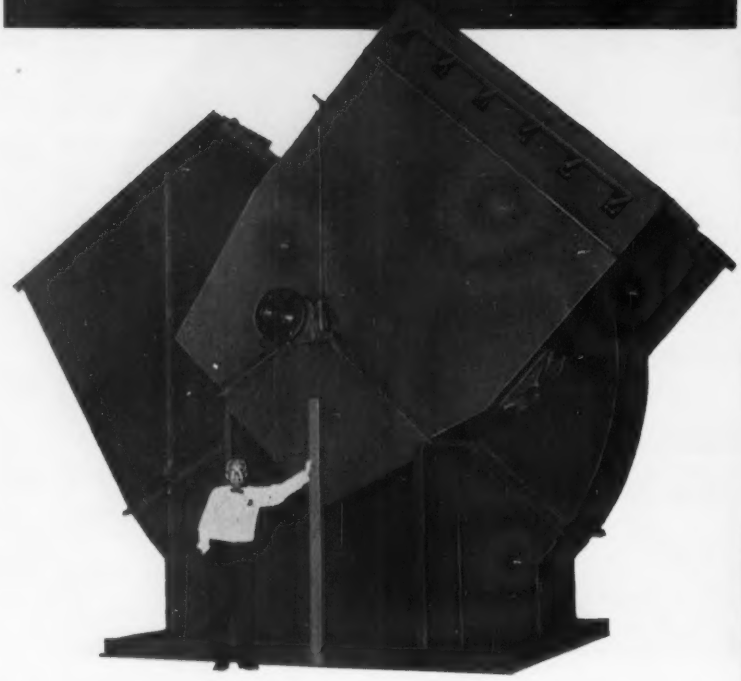

WHIRLEX HEAVY DUTY FANS
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This heavy duty WHIRLEX exhaust fan was custom designed for iron ore sintering machine. The unit is designed to carry hot gases at the rate of 200,000 CFM with 35 in. W.G. static pressure and is complete with scroll liner, cheek plate liner, blade wear pads, inlet louvre control dampers and removable section.

Additional facts and operating data on this and other WHIRLEX custom design fans are available at your request.

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Dust Collectors • Induced Draft Fans
Forced Draft Fans • Exhaust Fans
Self Supporting Stacks • Duct Work

FLY ASH WHIRLEX ARRESTOR

Free literature

Begins on page 100

152 **Locator** for pipes, valves and cables, a transistorized unit, is described in 2-p bulletin, Gardiner Electronics Company

MECHANICAL POWER TRANSMISSION

153 **Gearmotors and fluid drives** are detailed in 48-p book 2747. Selection data, dimensions, overhung load ratings and mountings are listed. Accessories include couplings, backstops and slide rails. Link-Belt Company

154 **Quick-coupling assemblies** are described in 8-p catalog F-10-R. Bronze, aluminum, monel, stainless-steel and semisteel models are available. OPW-Jordan

155 **Flexible shafts,** clutches, gearboxes, tachometers are listed in 14-p catalog. Barbour Stockwell Instruments

156 **De magnetic brakes** are detailed in 4-p bulletin 5000. Maintenance procedures are illustrated. The Electric Controller & Mfg Co

PUMPS

157 **Herringbone gear pumps** are covered in 4-p bulletin G-1. Dimensional data, driving power requirements are included. Schutte and Koerting Company

158 **Solids pump** for heavy-duty slurry handling is topic of bulletin 189. Morris Machine Works

VALVES, PIPING, FITTINGS AND SPECIALTIES

159 **Differential-pressure** regulators for steam service are topic of catalog sheet PR 10-58. Atlas Valve Company

160 **Small valves** for general applications are topic of 4-p brochure KS-1-N. Kerotest Manufacturing Company

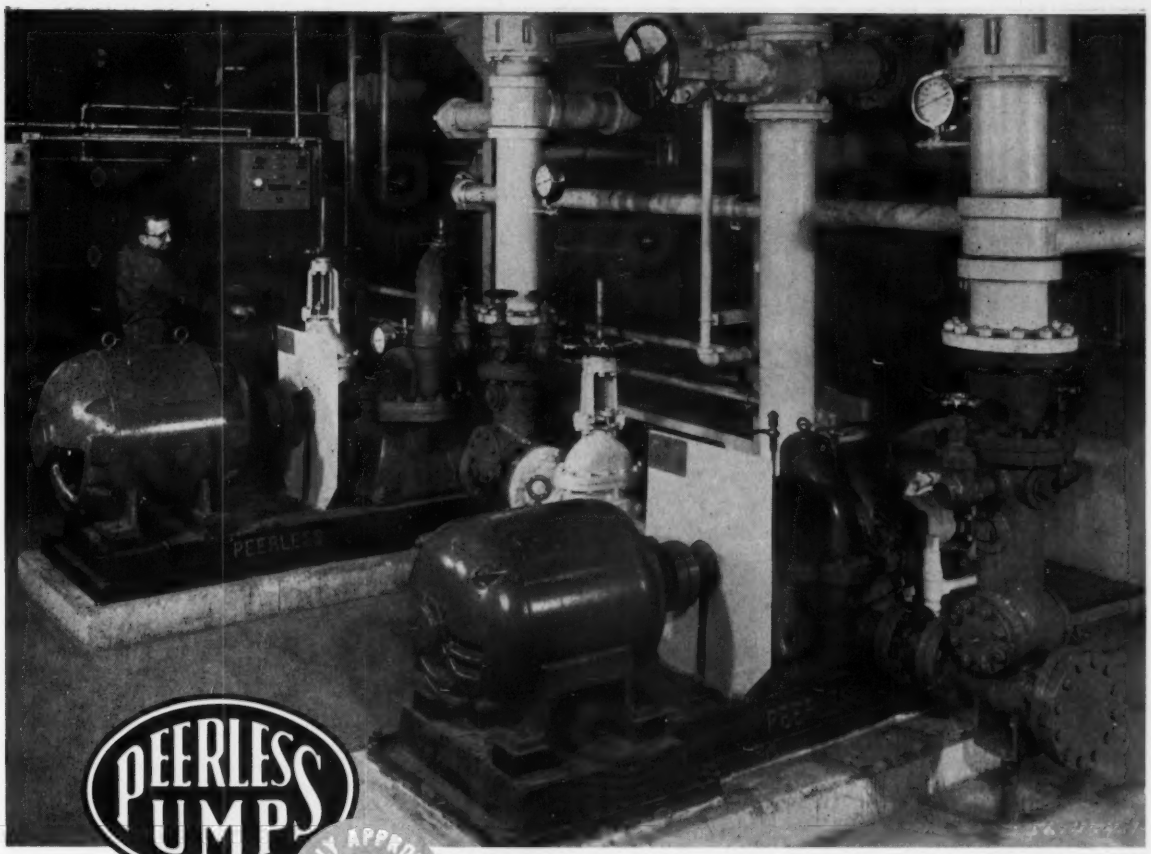
161 **Fully jacketed** stainless-steel valves for fluids difficult to move at room temperature are topic of bulletin 3. Alloy Steel Products Company, Inc

162 **Safety relief valves** are detailed in 88-p catalog 88. Valves from ½ to 6 in., made of bronze, semisteel or steel are described and illustrated. Includes extensive engineering charts and data. Marine & Industrial Products Co

163 **Temperature-control** valve, sliding-gate self-operated unit, is subject of 4-p folder J-180. OPW-Jordan

164 **Steam specialties**—valves, thermostatic traps, steam traps—are featured in 12-p bulletin 203. American Air Filter Co, Inc

continued



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FIRE PUMPS...

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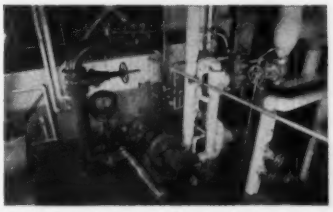
UNDERWRITERS' LABORATORIES INC. AND ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES

Prudential Insurance Co. takes no chances on fire in its recently erected Chicago Office Building. Peerless pumps give immediate protection against fire *automatically*, without human attention.

HOW TO DEAL WITH A FIRE BEFORE IT STARTS!

To insure adequate protection against the hazards of fire, a qualified independent fire protection system is a must. And to be doubly sure of the best system, the vital heart of the unit, the pump, should be the best money can buy. That's where Peerless *fully-approved* fire pumps excell.

Throughout a third of a century, Peerless fire pumps have attained an enviable and pre-eminent reputation in protecting all types of buildings, plants and warehouses. Put this know-how to work on your protection problem. See how Peerless' combination of top quality fire pump equipment, exacting engineering application and nationwide service can serve you best. In many instances, the savings effected thru more favorable insurance premiums can pay for the installation. For fire pumps at their very best look to the leader, look to Peerless. Write for bulletin B-1500 today.



Available with steam turbine, engine or electric motor drives, Peerless fire pumps are available for high pressure sprinkler systems, or foam smothering systems in every kind of commercial, or industrial installation.

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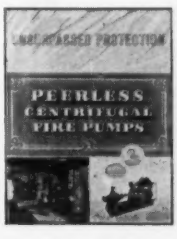

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Gentlemen: Please send me immediately a copy of your Bulletin B-1500.

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For more facts circle 254 on Reader Service card, p 99

LOOK!

Look at this 54,000 Sq.ft. Conseco Condenser. Only the other day it was shipped, completely tubed, to Dairyland Power Cooperative, Alma, Wisconsin from the Conseco Plant in Hoboken, N.J., following the shipment of a 35,000 Sq.ft. unit to the same client.

Yes, for price and quality, Conseco shell tubular equipment is your soundest investment, because Conseco alone, with 35 years experience, produces the whole job, "from blueprint to operation". That's why a Conseco bid is far less than the matter of today's dollars—it's your guarantee of the MOST from every dollar in years to come.

CONSECO designs, builds, engineers, delivers, installs, maintains and repairs all Condensing, Feedwater Heating, Evaporating, Air Removal and Condensate Cooling Equipment for any Thermal Power Generating Plant.

Want more data? Write for latest Steam Condenser Bulletin to Condenser Service & Engineering Co., Inc., *164 Observer Highway, Hoboken, N. J. (New Jersey Phone OLdfield 9-4425 or NYC BArclay 7-0600 and see Chem. Eng. Catalog pages 1035-1038.)*

Free literature

Begins on page 100

165 **Manifolds** for gases are discussed in 24-p catalog 829. Capacities, dimensions and arrangements are listed. Air Reduction Sales Co

166 **Piping dimensions** and weight per ft of pipe in ⅛- to 36-in. sizes for all schedules are listed on 4-p data card TDC-191. The Babcock & Wilcox Company, Tubular Products Div

167 **Supercritical power piping** for Eddystone's 5000-psi 1200-F unit is topic of 12-p brochure. Piping story is told from selection to erection. The M W Kellogg Company, Fabricated Products Div

168 **Welded carbon** and stainless-steel tubing is topic of 12-p brochure. Size ranges, applications, welding are described. The Formed Steel Tube Institute

169 **Hose fittings** for air, spray, welding are covered in 4-p bulletin 198. Hose Accessories Company

170 **Spray nozzles** for medium to large quantities are subject of 2-p bulletin 6A-622-1. Schutte and Koerting Company

171 **Pressure plugs** which seat flush in hydraulic, pneumatic and other h-p systems are covered in 4-p bulletin 2501. Standard Pressed Steel Co

172 **Strainers** for medium and fine work at pressures to 125 psig are topic of 2-p bulletin 9S-A. Schutte and Koerting Company

173 **Industrial O-rings,** other seals are topic of 24-p fact book. Includes specs, size charts, installation guides. Minnesota Rubber Co

WATER TREATMENT

174 **Water-treatment equipment** line is discussed in 4-p bulletin SM-1013. Clarifiers, mixers and contactors are shown. Process Engineers, Inc

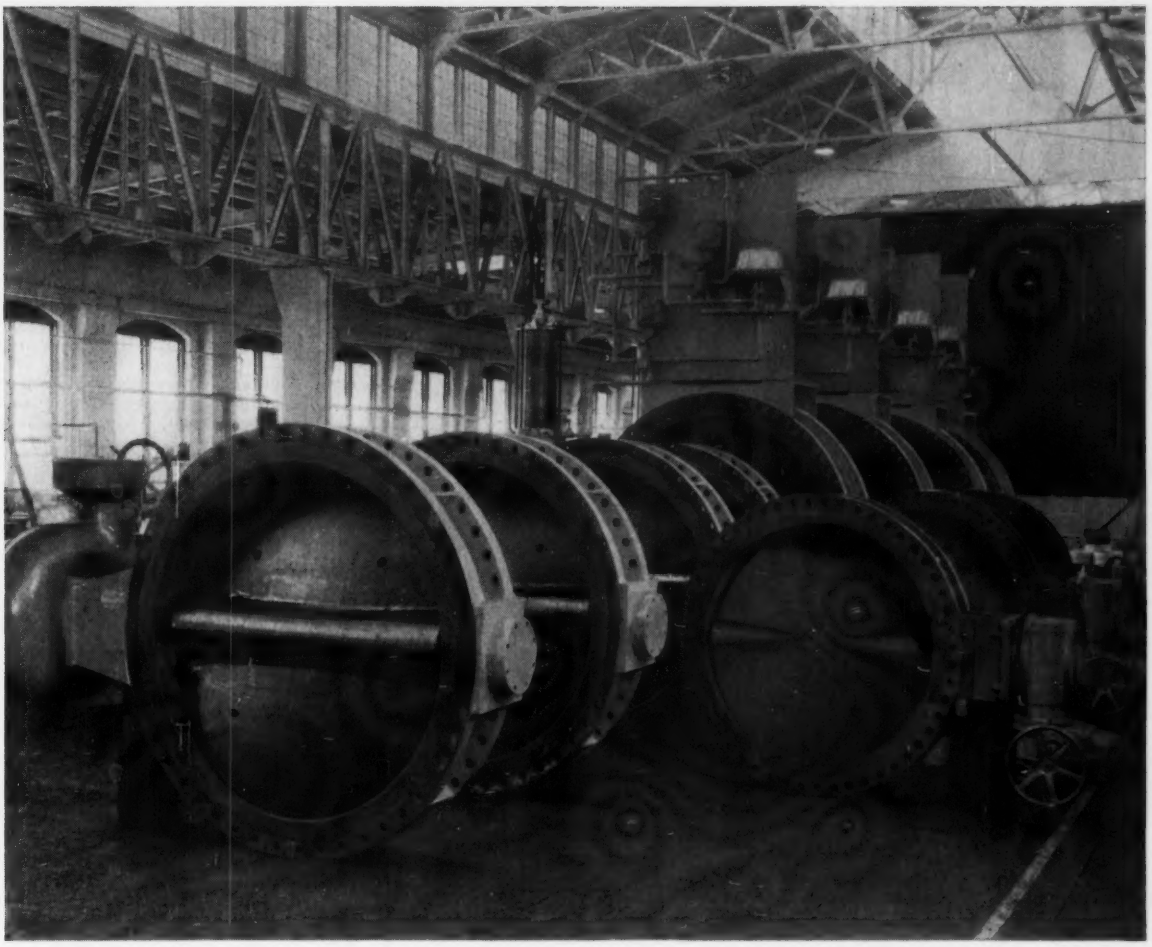
175 **Boiler feedwater** treatment in paper plants is topic of technical reprint. 120 Cochrane Corp

MISCELLANEOUS

176 **Tables and formulas** for electrical data, properties of materials, heat transfer and steam info, measurements are included in 120-p pocket-sized booklet B-3677D. Westinghouse Electric Corporation

177 **Differential-pressure power** unit utilizes gas flow to develop bonus power—6-p folder gives details. Troy Engine & Machine Co

178 **Packaged boilers,** 2-pass firetube models, are subject of 4-p bulle-



60-inch, 72-inch and 90-inch rubber-seated butterfly valves are shown prior to shipment from Allis-Chalmers Plant #1 at the York works. Note how the through-type rubber body liner completely covers and protects the bore of the valve.

Get **COMPLETE BODY PROTECTION** with Allis-Chalmers Rubber-Seated Butterfly Valves

You will find Allis-Chalmers rubber-seated butterfly valves will give dependable operation and few maintenance problems. The A-C through-type rubber seat covers the entire inner body to assure complete internal protection, eliminate tuberculation and oxidation. You get a smoother flow pattern, with no inner mechanical retaining plates to corrode or dislodge.

Allis-Chalmers rubber-seated butterfly valves are easy to operate, will provide 100% effective shutoff with a 125-pound pressure drop. Wedging action of the vane against the tough flexible rubber seat assures positive closure, even around the shaft bosses. By resetting the stops in the operator these angle-seated vanes can be adjusted to give tight shutoff throughout the life of the valve.

To obtain complete information on power plant applications for the full Allis-Chalmers line of butterfly valves, Rotovalves and ball valves, contact your A-C Valve Representative, or write to Allis-Chalmers, Hydraulic Division, York, Pennsylvania.

Hydraulic Division RESEARCH DESIGN HYDRODYNAMICS ENGINEERING FABRICATION

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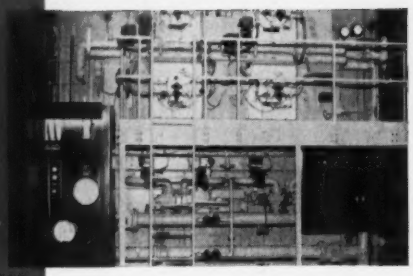
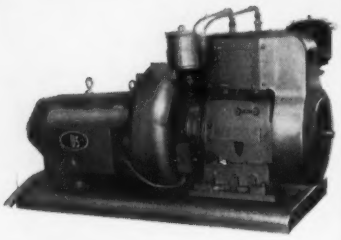
eliminates the risk of flame-outs caused by power outages with . . .



MICRO-POWER



In plants like Douglas Aircraft Company, Inc., in Tulsa, Oklahoma, where a continual supply of steam is vital to production processes, every precaution must be taken to assure against the hazards of boiler flame-out. To safely regulate the shutting down of its burners in the event of flame-out, the company utilizes highly sensitive electric controls. Since these flame failure controls *are* electric and must depend on a constant, unwavering power supply for successful operation, a further precaution is taken . . . MICRO-POWER.

At Douglas Aircraft in Tulsa, Micro-Power serves as the dependable rear guard to the boiler room. It provides a constant source of steady, independent electrical power as required by the safety controls, thereby eliminating voltage fluctuations and protecting against power failure.

MICRO-POWER IS ALSO USED . . .

- on microwave installations for communications, for remote control, for telemetering.
- for refinery and chemical process indication and control.
- by public utilities for protective relaying, telemetering and load distribution.

MICRO-POWER PROVIDES . . .

- a constant source of electric power.
- voltage and frequency at usable value during transfer from motor to engine.
- stable voltage output.
- flywheel starting — no storage batteries.
- electrical isolation from commercial source — no voltage dips or peaks to affect microwave equipment — no transfer switch.
- return to motor drive after commercial power restoration without interruption of voltage.

The Douglas Aircraft Company, Inc., Tulsa Division, "Micro-Power" application is just one of a wide range of uses for this versatile standby power unit. For complete product and application information, call or write . . .

MICRO US POWER — OSHKOSH • WISCONSIN

UNITED STATES MOTORS CORPORATION

102 West Fifth Avenue

OSHKOSH, WISCONSIN

Free literature

Begins on page 100

tin BE-100. Drawings, diagrams show features. Boiler Engineering & Supply Co, Inc

179 **Fire extinguishers,** dry-chemical type, are described, illustrated in 4-p brochure P-48. Walter Kidde & Company, Inc

180 **Canned pumps** for the nuclear industry are discussed in 7-p technical bulletin 4. Chempump Corp

181 **Welding fittings** and flanges are described in 12-p booklet FB-78. Specs, analyses, effects of alloying elements are covered. The Babcock & Wilcox Company

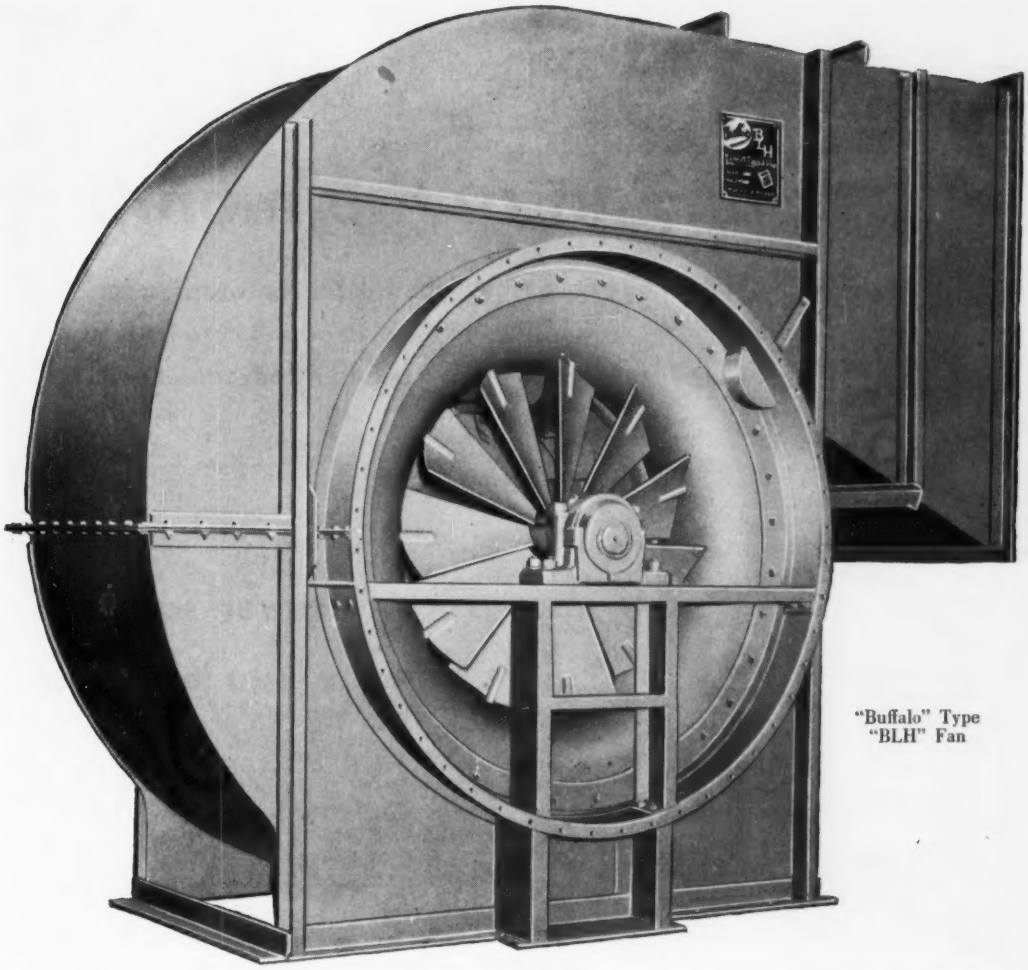
182 **Heat-transfer coils** are covered in 4-p bulletin 259. Dean Products, Inc, Dean Thermo-Panel Coil Div

★ EDITOR'S NOTE: *The following bulletin may be requested directly from manufacturer. Write on company letterhead to address below:*

★ **Industrial nozzles** are detailed in 32-p catalog 59. Info on spray angles, dimensions, types of connections, capacity vs pressure for standard nozzles is presented in selection tables. Wm Steinen Mfg Co, Industrial Nozzle Div, 45 Bruen St, Newark 5, N. J.

Demand for electricity in Europe will continue its upward climb at 7% increase per year for next five years. Nuclear power stations will play a significant part, according to Electricity Committee of Organization for European Economic Cooperation.

"He isn't doing too well on the aptitude test but he looks like a hard worker."



"Buffalo" Type
"BLH" Fan

HIGH EFFICIENCY OVER BROAD OPERATING RANGE PROBABLY YOUR BEST CHOICE FOR M. D. FANS

Does your mechanical draft installation require a fan that delivers peak-efficiency performance over a broad range? A fan that will give you this with the greatest possible long-range economy?

Then the "Buffalo" Type "BLH" is the fan you're looking for.

The "Buffalo" Type "BLH" Fan maintains a high mechanical efficiency over a very broad operating range. And it does this smoothly, quietly and most economically because of a number of important "Buffalo" design factors:

• Streamlined housing is uniquely engineered to provide smoothest air flow, highest possible static conversion and excellent pressure distribution at fan outlet.

• Minimizing turbulence are the smooth inlet bell, directional inlet vanes (standard, matching variable inlet vanes are optional) backward-curved blades, rotor flange curved to match inlet bell and the gradually divergent outlet. These features also result in extremely efficient performance and outstandingly stable operation from free delivery to shutoff.

• The 82 year old "Buffalo" reputation for rugged, dependable construction insures long, maintenance-free life.

If you're looking for this kind of efficiency and economy in a mechanical draft fan, call your nearby "Buffalo" engineering representative. Or write us for Bulletin FD-905.

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VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

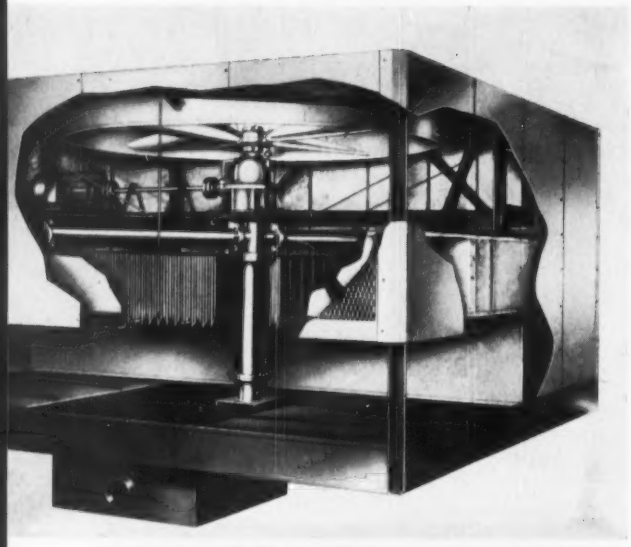
For more facts circle 258 on Reader Service card, p 99

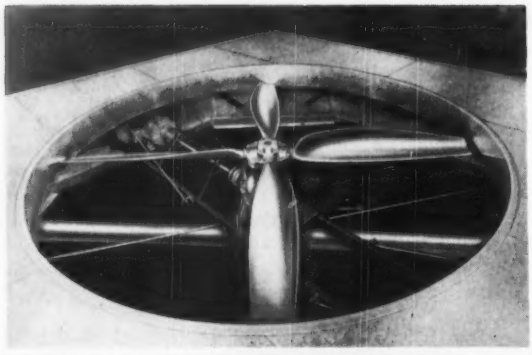
EXCLUSIVE

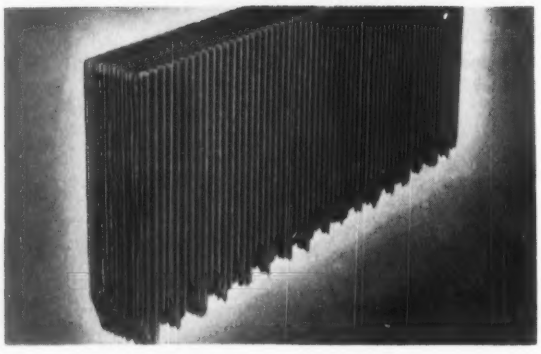
Equipment design of the month

On this page each month you will see the wraps taken off a significant new product at least 30 days before it's released to any other publication, and before it's advertised anywhere

By STEVE ELONKA
Associate Editor







New cooling tower squeezes more capacity into less space

Here's an entirely new concept in large-capacity cooling towers. Developed by Carrier Corp, important feature is a new fibrous fill resembling corrugated paper, but made of plastic-fortified wood cellulose. Perfected by Carrier the fill is a European discovery that can withstand time and chemicalization.

Water distribution is another new concept. System consists of a rotating header with two pipes extending in opposite direction from a vertical supply pipe in the center of the fill. A slot under the rotating arms lays a thin film of water over the entire surface of the fill, regardless of changes in flow rate. Heat-transfer efficiency is maintained because all flues in the fill are used. Since the header revolves so close to the top of fill pack, water fly is kept to a minimum and there is no need for a drift eliminator. A single eliminator sheet attached to trailing edge of the header arms restricts drifting.

Another exclusive feature is the water-powered rotating header. It's powered by only 3 ft of water and turns on near frictionless bearings.

Side casings are easily removed. In place of galvanized steel panels, unit can be furnished with stainless steel, Transite, glass fiber or coated metal to harmonize with building construction. The small air intake areas are covered with grilles.

Towers are all steel except for the fill. Capacity range is from 160 to 510 tons; multi-cell arrangements serve large tonnages. Because of the light fill used, operating weight of the tower is cut by 50%. Floor area of tower is reduced by 25%.

Where draft is induced by 4-bladed fan, units range from 61,750 to 184,600 cfm. Tower is square, weighs up to 17,985 lb.

For additional information
circle No. 95 on Reader Service card, page 99

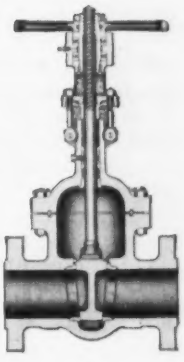
Replaced leaking valves with Crane gates No leaks...no maintenance...in 2 years

New gate valves, installed on steam lines to and from a fire-watch pump at a gasoline plant, leaked continually, almost from the day they were installed.

When frequent maintenance failed to stop the leaks, Crane steel wedge disc gates were installed. One valve was a 3-inch, 300-pound No. 33XR; the other one, a 4-inch, 150-pound No. 47XR—both rated for steam service at a maximum temperature of 850° F. Both valves have Exelloy discs and stems, and replaceable No. 49 Nickel Alloy, screwed-in body seat rings.

The switch to Crane valves was made two years ago. Since then, they have been in continuous operation. Not *one* leak has developed—and not *one* cent has been spent for maintenance.

Get the jump on your costly maintenance problems. Make original as well as replacement installations with Crane valves and other piping materials. For all facts about the many Crane valves used for refinery, pipeline and other services, see your Crane Representative or write to the address below.



Typical cross section of Crane steel wedge disc gate valves widely used in refinery, power and process services. Available in sizes up to 48 inches; for oil or oil vapor, steam, air, gas, gasoline, water and other services. In seven pressure classes—150-pound to 2500-pound, with temperatures to 1100°F. Choice of trim materials is most complete. Write for details.

CRANE® VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

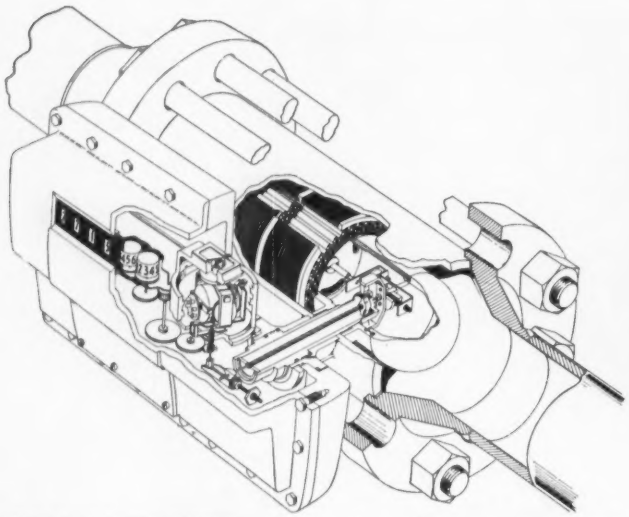
Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

For more facts circle 259 on Reader Service card, p 99

For more data on these developments, circle key numbers on Reader Service card, p 99

Plant equipment news... Your



"TRUE-MASS" FLOWMETER, *left,* is made up of flow-rate sensor, magnetic coupling between fixed turbine and integrating mechanism, gyro integrator geared to cyclometer register. Gyroscopic integrator, *right* totalizes flow directly and automatically

Flowmeter measures liquid, gas flow directly in pounds

1 • Simple, low-maintenance "true-mass" flowmeter measures the weight of fluids with high accuracy over wide ranges of flow rate, pressure, temperature and density. First production units, scheduled for early 1960, will meter gasoline, refinery and natural gas, oxygen and nitrogen, butane and propane. Future applications should include lighter gases; high-temperature, corrosive or cryogenic fluids—steam, acids.

Previous methods measured fluid volume, then corrected for temperature, pressure and density. New unit senses mass directly, with accuracy of $\pm 1\%$ of reading. Compatible with automation, it can emit a series of electrical pulses to operate remote counters, printers or totalizers. It runs from an unregulated power supply without appreciable loss of accuracy, according to the manufacturer.

Principal components are a small gyroscope, a flow-rate sensor made up of constant-speed impeller and stationary turbine arranged for axial flow: impeller twists fluid stream, turbine straightens it. Torque on turbine is proportional to mass rate of flow, and gyro integrates torque with respect to time. Output is continuously summed up on cyclometer dial in lb.—Black, Sivalls and Bryson, Inc (for natural-gas applications) and General Electric Co.

Telemetering system operates unattended

2 • Designed for sampling and telemetering remote measurements in power-distribution and utility systems, oil and gas pipelines, processes, this accurate system transmits over a single teletype, voice or microwave channel. Output signal is good for computer control.

System uses solid-state and other reliable components for dependability. A single system consists of transmitter and receiver capable of handling up to 30 data points with over 99% accuracy. A 1-point data system can be expanded up to the maximum 30 points in the field, maker states.—Applied Science Corporation of Princeton

Palm-sized meter maps out noise hazards

3 • Rapid, multilocation measurement of sound levels to establish noise-contour "maps" in large industrial plants is handled by this electric-shaver sized noise-survey meter. Unit weighs only 12 oz. It's housed in plastic, comes with a leather carrying case and a neck cord. To measure sound, you point meter toward noise source, switch on power from a mercury battery, adjust to an "on-scale" reading with a thumb-wheel attenuator, read sound pressure levels in range of 75 to 140 decibels. Meter is also said to be an accurate and convenient tool for acoustical design specialists.—Mine Safety Appliances Company

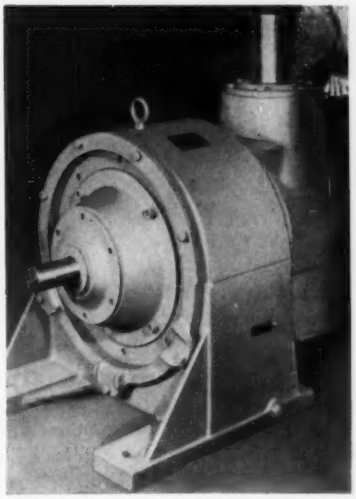
information center for new products and materials

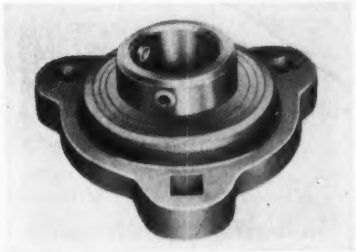
Standard reducers are now rated up to 200 hp

4 • Two large-size in-line gear-speed reducers boost existing drive series up to 200 hp—largest standard models ever produced by the company. High overall efficiencies for the power-transmission units run from 94 to 97%, depending on number of reductions needed. Double, triple and quadruple reductions come in AGMA ratios up to 440 to 1. Right-angle spiral bevel attachments, available to mount in eight drive positions at 45-deg increments, are shown at right of photo.

The speed reducers are built for maximum durability and strength. Carburized and hardened final-stage helical gearing, precision-ground teeth are long-life features, said to increase load-carrying capacity, reduce vibration and noise, give bonus space savings.

Large-diameter shafting, oversize bearings have reserve capacity to handle severe overhung loads and shock conditions, according to the manufacturer. Internally ribbed cast iron housings provide maximum strength and rigidity. Mounting stability is assured by board housing base which also provides a large oil reservoir. Gears, shafting and bearings are said to meet AGMA standards.—Philadelphia Gear Corp.

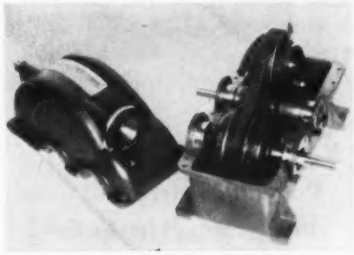




Precision bearing units feature 2-, 3-bolt flanges

5 • Bearing cartridge mounts permanently in strong, lightweight 1-piece malleable housing. Housing design permits flush or recessed mountings for flexibility, desired shaft extension with minimum overhang. The 2- and 3-bolt flange units are additions to firm's low-cost line.

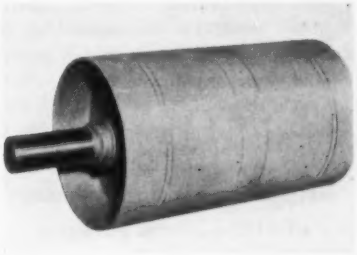
Self-alignment is automatic between spherical OD of bearing and ID of housing; centrifugal labyrinth seals keep lube in, dirt out. Sizes are ¾ to 1 7/16 in.—Stephens-Adamson Mfg Co, Sealmaster Bearing Div



Variable-speed transmission gives basically constant hp

6 • Unit is built around a new combination timing V-belt, provides 3:1 ratio was basically constant horsepower. A timing belt pulley drives the belt for constant ft-per-min travel. No-slip condition on driver, maximum-wrap condition on driven produces constant-hp transmission.

A segment of worm gear is mounted to an idler-carrying side plate for speed adjustment. Rated capacity is 1.5 hp with input speed of 1750 rpm. Transmission can operate in any position.—Western Manufacturing Co



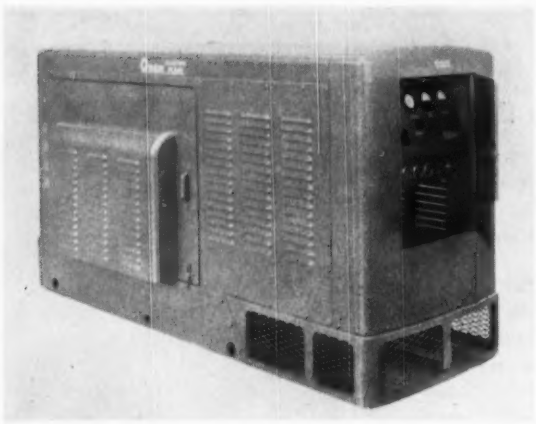
Ceramic magnetic pulleys provide deep magnetic field

7 • Designed for applications where long, medium or heavy tramp iron must be removed from fast-moving flows of material, ceramic magnetic pulleys are available in five standard diameters from 12 to 24 in., belt widths beginning at 12 in. Radially designed pulleys have magnetic poles extending around the circumference, so field varies across the face and is most highly concentrated at poles. For optimum efficiency, units should have ambient temperatures from 20 to 120 F.—Eriez Manufacturing Co

For more data on these developments, circle key numbers on Reader Service card, p 99

More **equipment news**

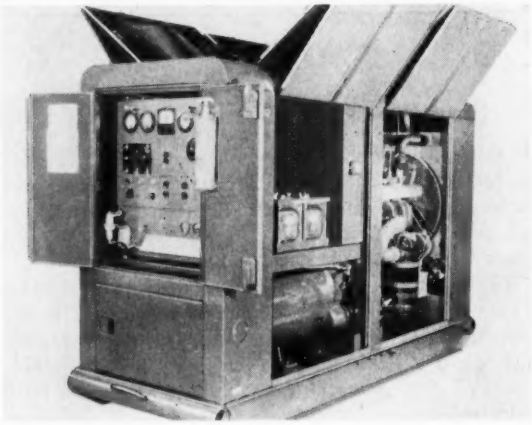
For more data on these developments, circle key numbers on Reader Service card, p 99



Standby plant boasts quick starting

8 • Exceptionally fast motor starting, full-rated power for all types of standby applications are features of new 50-kw gasoline-driven electric generating plants. Units cost $300 less than previous models, manufacturer states.

An all-weather metal housing is standard equipment, making units practical for heavy duty in many primary power applications. Engine, control panel and "Magneciter" generator are assembled into a compact unit, rated 50 kw, 62.5 kva at 0.8 power factor. *Series KB* plants come in voltages to 600 v.—D W Onan & Sons Inc



Rugged diesel plant rated 60 kw

9 • Water-cooled 6-cylinder diesel engine develops a speed of 1800 rpm in this 60-kw diesel electric generating plant. The unitized 3-phase 60-cycle set has an output of 120/208-v ac. Standard equipment includes 24-v electric-starting and battery-charging systems.

Enclosed control panel is mounted as a single unit, with ac instruments and controls contained in a vibration-free box on the panel. Coupled engine-generator assembly mounts on a rugged fabricated-steel sub-base. Units handle standby or constant-power service.—Jeta, Inc

Brushless generator is heart of 100-175-kw package

10 • Shorter, streamlined brushless generator has auxiliary equipment compactly mounted. Enclosure gives dripproof protection to generator, exciter, regulator and instrument package. Switchboard mounts directly on top, keeping down cable runs.

Instruments are in a side recess, which also shelters a completely static forced-cooled current-compounded voltage regulator. For flexibility, conduit entry is made from left to right with removable plates.

Various adapters are available to attach generator to most drivers. Units come in 100-, 125-, 150- and 175-kw 60-cycle 1800-rpm models.—Allis-Chalmers Manufacturing Co

Portable instrument tests insulating oil in the field

11 • Lightweight, compact unit is used for on-the-spot testing of insulating oils in transformers, high-voltage capacitors, bushings or oil-immersed components and power supplies. Complete portability means that high-voltage breakdown tests can be made wherever electrical equipment is located. Model *4504-A* weighs only 42 lb, 33 lb less than its predecessor; it measures 8½x16x8 in.

Test voltage is continuously adjustable from 0- to 35-kv ac at a 2-kva rating to meet ASTM specs. Test potential measured directly at test electrodes insures accuracy, maker states. Set operates from 110-120-v ac, costs $725.—Associated Research, Inc

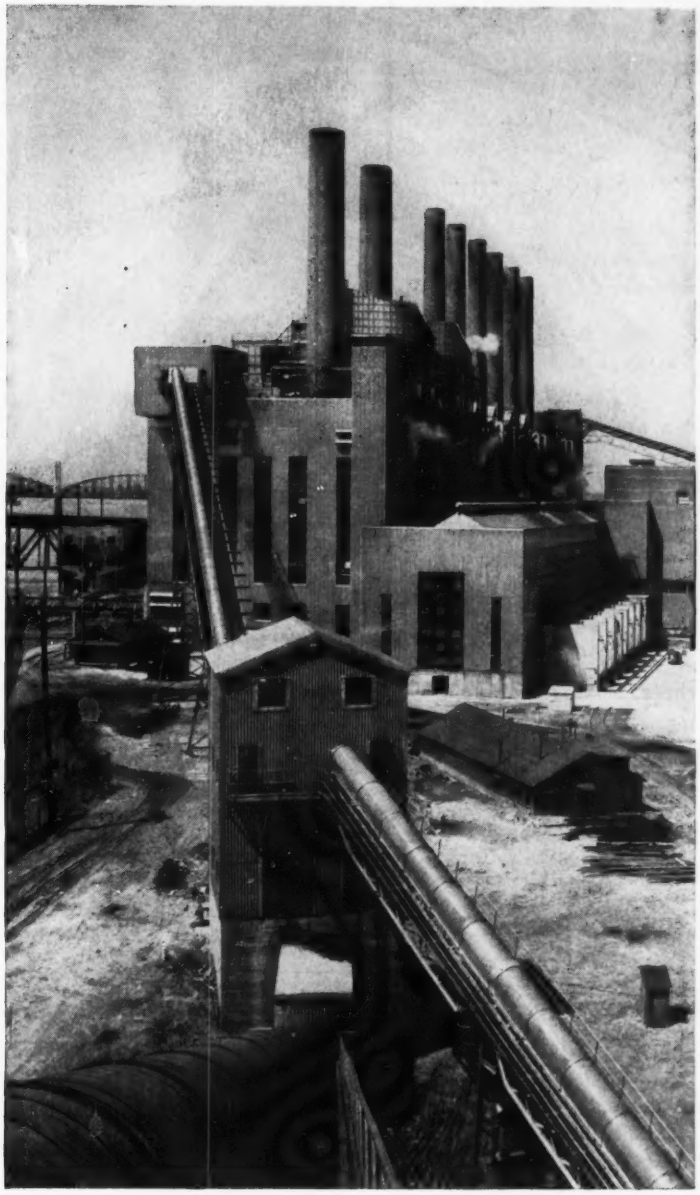
Dielectric test set comes in portable, bench models

12 • Set handles step-voltage resistance, voltage withstand, breakdown and 1-min resistance tests on insulation in electrical equipment with voltage ratings in 300-, 600- and 2500-v classes. Portable and bench models are available. Maximum voltage is 5 kv at 1 ma; maximum output current is 5 ma at up to 2.5 kv.

Unit is used with rotating electrical machinery, dry type transformers, switchgear, capacitors and insulators rated 230-2500 v ac and dc; traction motors and generators rated 600 v; wiring installations and cable. Portable set is housed in a shock- and wear-resistant case for field use. It weighs 26 lb.—James G. Biddle Co.

For more data on these developments, circle key numbers on Reader Service card, p 99

COMPLETE COAL HANDLING BY H&P



H & P Coal breaker and sampling facilities for initial installation; coal conveyors, structures and sampling facilities for extension.
Union Electric Company, Venice No. 2 Power Plant.
Engineers & Constructors: Stone & Webster Engineering Corporation.

For dependable coal handling at low cost, rely on H&P's experience. Whether it's unloading from barges or railroad cars, conveying, stocking and reclaiming, crushing, sampling and weighing—H & P provides you with a single source and delivers a carefully engineered, well-built installation, assuring long years of trouble-free service.

An H & P Contracting Engineer can assist you in developing the most practical method of handling your coal out of barges or railroad cars, to and from stockpile and into your bunkers.

Other H & P products for Bulk Materials Handling:

Rotary Car Dumpers
•
Barge & Car Hauls
•
Barge & Boat Unloaders
•
Kinney Car Unloaders (for frozen coal)
•
Bradford Coal Breakers
•
Coal Sampling Systems
•
Specialized Conveying Systems

HEYL & PATTERSON, inc.

55 FORT PITT BLVD., PITTSBURGH 22, PA. • COurt 1-0750

For more facts circle 260 on Reader Service card, p 99

FILL IN AND MAIL TO
WESTERN CHEMICAL COMPANY
Kansas City 5, Mo.
Pioneers in the chemical control of problems relating to the use of water, steam and fuel

"I have a problem..."

- ☐ scale, corrosion, or foaming in my boiler operation
- ☐ rust and corrosion in my steam and condensate return lines
- ☐ scale, corrosion, or algae growth in my cooling or condenser water system
- ☐ corrosion or scale in my potable or plant water supply lines and tanks
- ☐ rust and corrosion in my brine or sweet water system
- ☐ scaled up pumps, water jackets, compressors, coils, lines, or equipment
- ☐ sludge and moisture in my fuel oil supply
- ☐ soot deposits in my furnace combustion areas

"I'd like to know..."

. . . exactly what specific treatment your Technical Services Dept. recommends. I understand that such problems have been your specialty for over 65 years and that you have an outstanding record for restoring and maintaining efficiency of plant equipment through advanced chemical treatment. Will look forward to receiving in the near future both your latest technical literature *and* a personal letter concerning my problem. I understand that my inquiry involves no obligation.

NAME_____ TITLE_____

FIRM_____

ADDRESS_____

CITY_____

ZONE_____ STATE_____

Mail to Technical Services Dept., WESTERN CHEMICAL CO.
713 Washington St., Kansas City 5, Mo.

Equipment news

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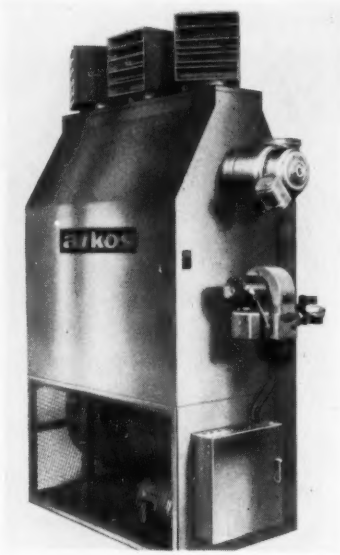
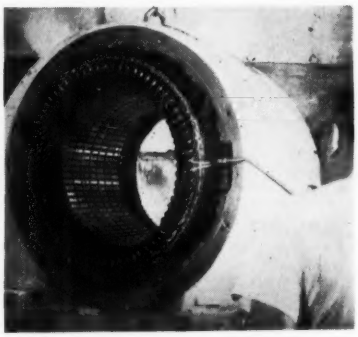


Direct-fired heaters

33 • Units feature a stainless-steel combustion chamber with 4-point floating suspension to allow free movement during heating and cooling cycles. Economizer tubes are installed above combustion chamber, swaged into headers to eliminate stresses and buckling.

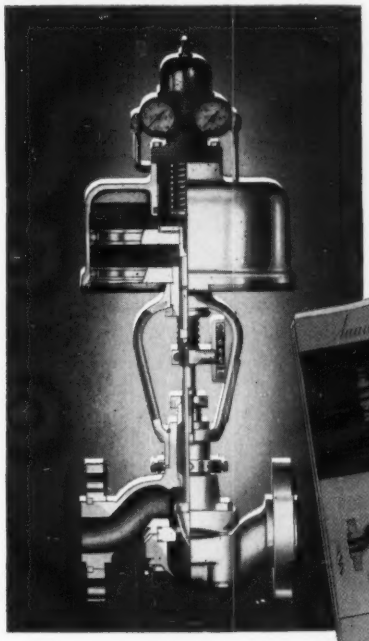
Standard capacities are 400,000 to 3,500,000 Btu with light-oil, heavy-oil, gas or oil-gas burners.—**Arkos** Manufacturing Co

Just circle key numbers on the Reader Service card, page 99, to get complete product story



Epoxy motor material

15 • Low-cost protection for electrical equipment operating in chemical environments and high humidities is provided by *Epoxylite 213*. It can be brushed or sprayed with conventional equipment and combines



HOW ANNIN DOES IT.

The Best Way Yet in Process Control

SPLIT BODY CONSTRUCTION... SINGLE SEAT DESIGN

No other process control valve offers the advantages in economy and adaptability as that provided by the Annin valve. The split body eliminates pockets and shoulders that create undesirable turbulence and accumulated solids, reduces erosion and allows consistent flow behavior with a wide range of fluids under all conditions.

Superior body design permits conversion in any alloy from the basic Globe Body to Corner, Angle or 3-way construction.

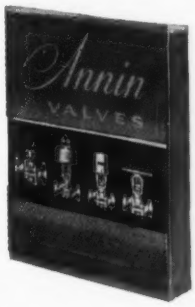
OPERATORS

Three basic Annin operators bring new and improved performance. The DOMOTOR operator is the most responsive, precise positioning and fastest pneumatic operator available... Electro-pneumatic or pneumatic CYLINDER operators, for remote shut-off applications, are designed to withstand continuous "on-off" operations... MANUAL operators, for precise throttling of flow rate and tight closure.

INTERCHANGEABILITY OF COMPONENTS

Applications unlimited are provided by interchangeability of Annin component features. Three types of operators, and five types of packing assemblies (plain extension, bellows seal, doolseal, cooling fin and standard) are interchangeable on one yoke and one body.

SEND FOR THE ANNIN CATALOG—
AN ENCYCLOPEDIA OF VALVE EXPERIENCE AND LEADERSHIP



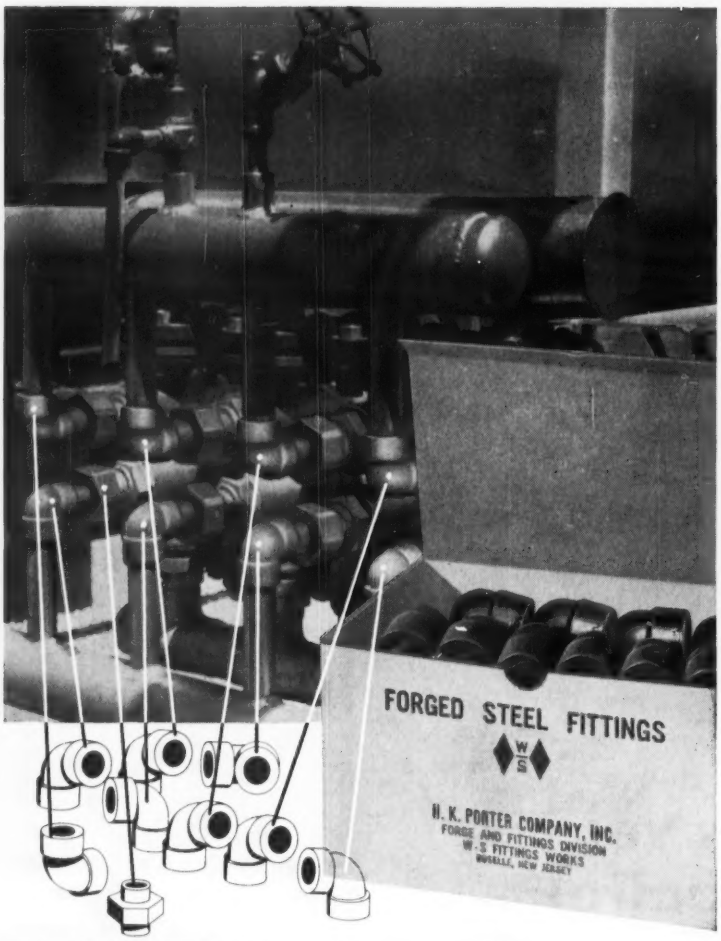
SIMPLICITY IN DESIGN AND MAINTENANCE

The advantages of Annin single seat, split valve bodies, coupled with the design characteristics of Annin Domotor and other operators, provide control engineers with valves that can be installed without compromise in materials, response, tight closure, piping flexibility and dependability... making possible a reduction of parts from 50% to 75%, lower initial cost, lower spare parts inventory, lower maintenance.

THE ANNIN COMPANY
Division of The Annin Corporation
1040 S. Vail Ave., Montebello, California

ANNIN VALVES

For more facts circle 262 on Reader Service card, p 99



FORGED for long life
PACKAGED for convenience

The "Forged" in W-S Forged Fittings means dependability under the toughest piping-job conditions. "Forged" gives you the added resistance to pressure, heat, corrosion, shock and vibration needed to make your installations long-lived and safe. And W-S Fittings are easily installed, with tight fits and perfect alignment . . . thanks to W-S precision machining methods and quality forging techniques.

Packaging, too, is a W-S brand advantage. Virtually any "mix" of fitting types and sizes can be packed in a convenient W-S Case or Half-case . . . each type and size in its own carton.

Specify W-S on your next order. For specifications and Distributor locations, write *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, New Jersey.*

FORGE AND PORTER FITTINGS DIVISION

H.K. PORTER COMPANY, INC.

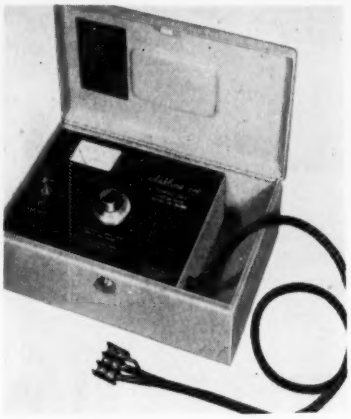
PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Copper and Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

Equipment news

Begins on page 112

the handling ease of varnish with chemical resistance of paste, maker states.

Material can be applied to stator or armature windings, field coils and form coils. It cures overnight at room temperature, or in a 275-F oven in 15 minutes. The tough, rubbery seal has high dielectric strength for Class A or B service. It withstands overload at 400 F.—The Epoxylite Corporation

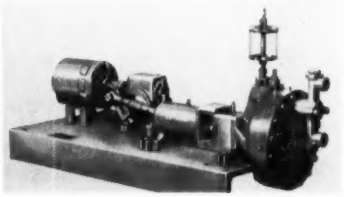


Portable corrosion tester

52 • Lightweight unit reads directly in microinches of corrosion. It should see service in paper and pulp plants, chemical and plastics manufacturing and all kinds of cathodic-protection programs.

Tester is battery operated. It applies alternating current to the probes, eliminating polarization. Single knob controls a sensitive transistorized bridge circuit working on the null principal.—Soiltest, Inc

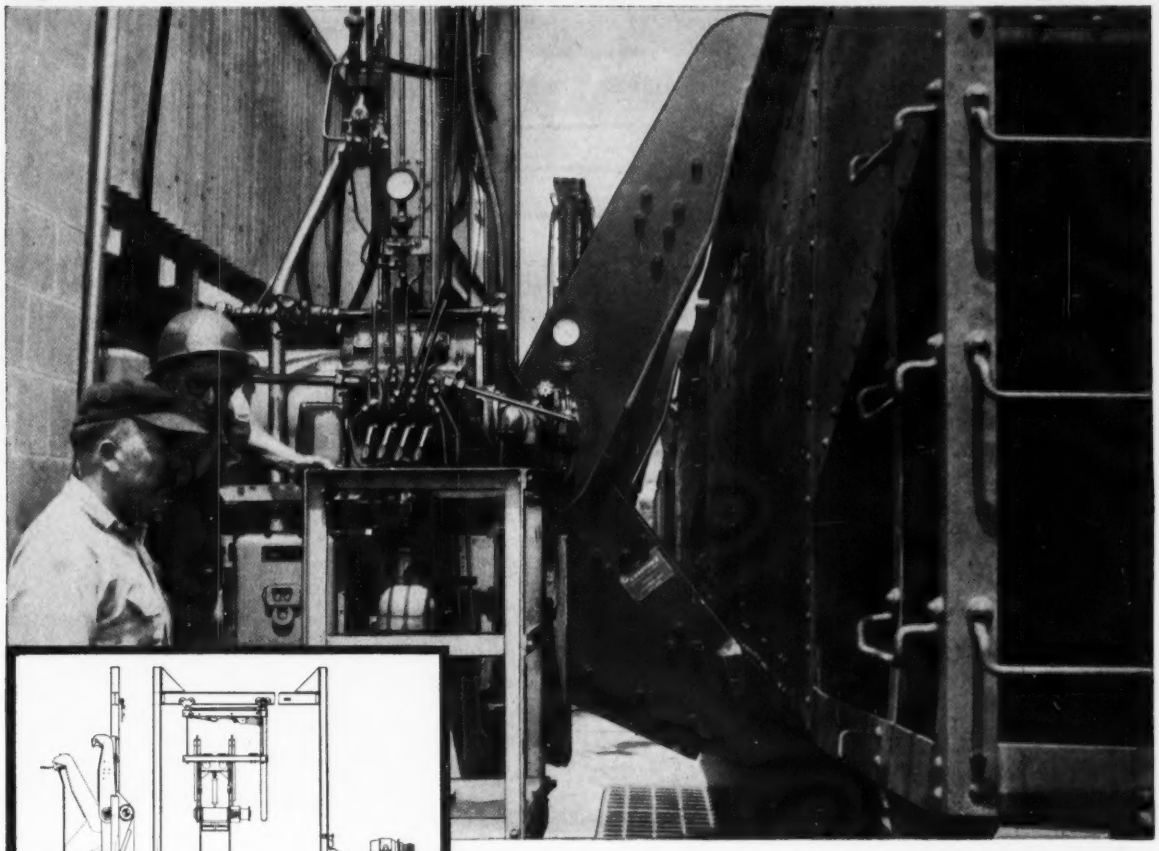
Just circle key numbers on the Reader Service card, page 99, to get complete product story

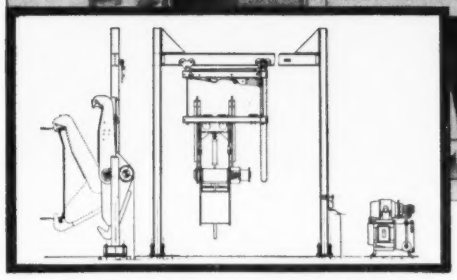


Metering pumps

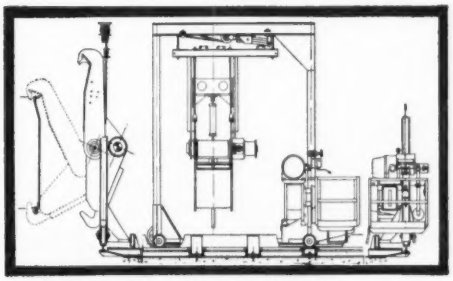
42 • Lab and industrial service is handled by controlled-capacity metering pumps. The line includes plunger

STEPHENS-ADAMSON





TYPE "B" STATIONARY MOUNTED CARQUAKE
Designed for applications where only slight movement parallel to hopper cars and tracks is required. The unit is mounted to the customer's concrete hopper foundation or steel structure with anchor bolts.



TYPE "C" RAIL MOUNTED CARQUAKE
Mounted on rails permitting travel any desired distance and unloading into any hopper. Concrete piers or steel structure for anchoring rails are all customer need furnish.

NOW! MINIMUM NOISE WITH MAXIMUM EFFICIENCY IN UNLOADING HOPPER CARS

HYDRAULICALLY POWERED

SA CARQUAKE

- One man unloads hopper-bottom railroad cars quickly, efficiently and with less noise than overhead car shakeouts.
- Hydraulically powered vibration with speed controlled to match required capacity.
- No expensive overhead structures needed — a completely self-contained unit—unlimited movement parallel to track.
- Avoids demurrage charges — saves manpower — speeds unloading operations.

WRITE FOR BULLETIN 658

S-A

ENGINEERING DIVISION
STEPHENS-ADAMSON MFG. CO.
GENERAL OFFICE & MAIN PLANT, 5 RIDGEWAY AVENUE, AURORA, ILLINOIS
PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

For more facts circle 264 on Reader Service card, p 99

any way you look at it...

YARWAY REMOTE LIQUID LEVEL INDICATOR GIVES BRIGHT, INSTANT, ACCURATE READINGS

On its brilliant "wide vision" dial you can clearly read the level from any point in a 180° arc—and from a considerable distance.

Remote readings of levels in boilers, feed water heaters and other heat exchangers are instant and accurate because indicator operating mechanism is actuated by the varying head of the liquid itself, yet the pointer mechanism is never under pressure.

Yarway Indicators may be arranged to operate remote Yarway Electronic Secondary Indicators or remote Hi-Lo Alarm Signals (lights or horns) located anywhere in the plant.

A record of nearly 13,000 successful installations speaks for itself.

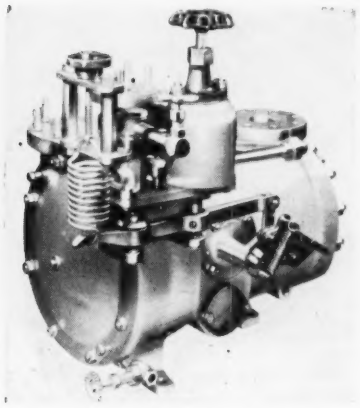
For details on construction, operation, installation and typical hook-ups, write for Yarway Bulletin RI-1825.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

Begins on page 112

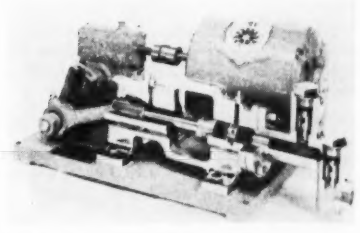
and diaphragm type units, both operating on the reciprocating action of a positive-displacement plunger—diaphragm type has a Teflon diaphragm for corrosive service. You can convert from one type to the other by switching liquid-end assemblies. Capacities range from one drop per 13 strokes to 1000 gph.—The Clark-Cooper Company, Inc



Packaged turbine pump

30 • Medium-volume high-pressure boiler-feed and general service are handled by this pump. Compact unit comes complete with all controls for constant- or differential-pressure regulation, providing a wide operating range.

Single-stage design has turbine, pump and control integrated. Pump parts are precision-built for high-speed operation with minimum steam consumption. Capacity is 180 gpm, discharge pressures range up to 350 psig.—Coffin Turbo Pump Co

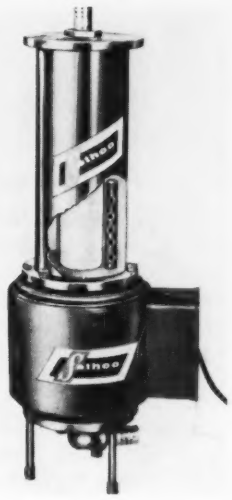


H-p proportioning pumps

43 • High-pressure low-capacity variable-volume reciprocating plunger pumps feed as little as 1.5, as much as 108 gph. Corrosive or non-corrosive liquids are taken in stride for chemical-process, food-process and water-treatment applications.

Units handle pressures up to 625 psi; special models extend range to several thousand psi. Materials available are 304 and 316 stainless, Hastelloy, Carpenter 20 and other steels. Manual or automatic stroke adjustment can be made from zero to full stroke while unit is in operation.—Walter H Eagan Co, Inc

Just circle key numbers on the Reader Service card, page 99, to get complete product story



Canned filter pump

44 • Stainless steel *Series SEI* is a space-saving portable filter pump. Designed to filter solvents and ultrasonic cleaners, units house pump, motor, filter chamber and filter tube together. Pump is inside motor housing and is magnetically driven by the motor, eliminating stuffing boxes, rotary seals and shaft wear and providing longer service life, according to maker. A ⅛-hp totally enclosed 110-volt 60-cycle 1-phase motor drives the pump.—Sethco Manufacturing Corp

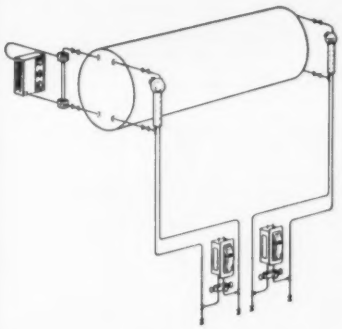
Portable rotary compressor

51 • Capacity almost 20% greater than previous model is offered by 250-cfm compressor. Larger, more powerful engine retains the 1800-rpm speed of former model. Fuel and air tanks are under housing, with a cover

HOW BOILER CODE CASE #1155 EXTENDS USE OF YARWAY REMOTE INDICATOR

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used instead of one of two required gage glasses for boiler pressures 900 psi and above. When both indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and can be used for primary boiler water level indication in plants operating at 900 psi and above. Sketch below shows typical hook-up.

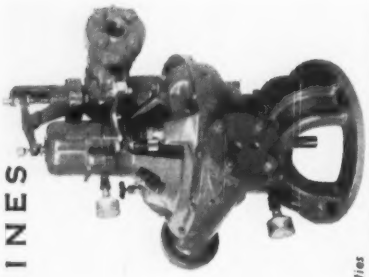


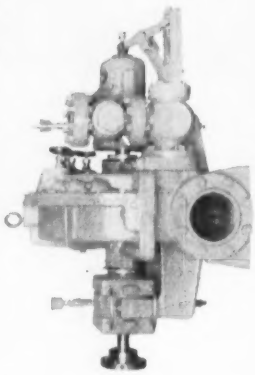
If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

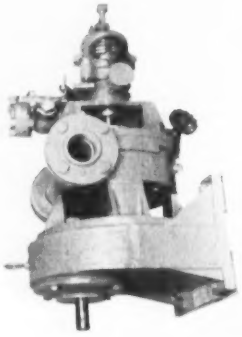
YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

circle 266 on Reader Service card, p 99







FOR 40 YEARS . . . THE QUALITY NAME IN TURBINES

CARLING TURBINE BLOWER CO. 7 NEBRASKA ST. WORCESTER, MASS. *Representatives in Principal cities*

WRITE FOR BULLETIN 20-C-3

CARLING TURBINES

Equipment news

Begins on page 112

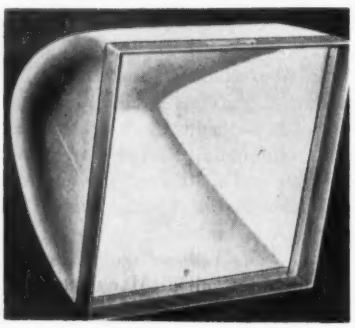
that can be locked. Gyro-Flow 250 comes with diesel or gasoline engine, with two- or four-wheel mounting or ready for truck or skid mounting.—Ingersoll-Rand Company

Nuclear control modules

35 • Compact building-block units are flexible, can be grouped to meet individual requirements of any type of reactor, according to maker. Plug-in modules simplify calibration, operation and maintenance—the operator can check control system and components while reactor is working.

Pulse, log-N or intermediate, linear-servo and safety channels are available.—Leeds & Northrup Co

Just circle key numbers on the Reader Service card, page 99, to get complete product story



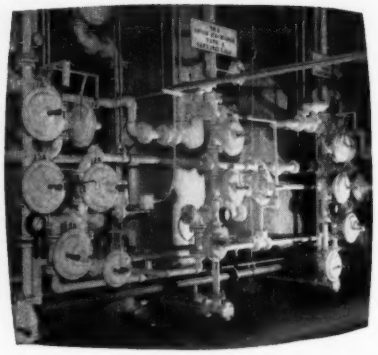
Parabolic filter

37 • Efficiency, good dust-holding capacity and low initial resistance at modest cost are features of parabolic disposable-bag filter. Unit is engineered for air-conditioning, heating and ventilating systems. Parabolic shape means filtering action is strong-

THESE NEW IDEAS HAVE COME FROM

ILLCO-WAY DESIGNERS AND BUILDERS

MODERN EQUIPMENT FOR ionXchange



Illinois Water Treatment Co. was incorporated over 20 years ago to use the newly-discovered resins in the development of ionXchangers.

1942 By this time, IWT had already built more than 50 successful multi-bed ion-Xchangers (some of which are still in use today).

1943 IWT brought "automation" to ionXchange with the introduction of automatic ionXchangers, some of which were very large. (Some of *these* are still operating today, also.)

1947 This was the year when IWT brought out the first large (400 gpm) ion-Xchanger for silica removal.

1949 IWT built the first commercial *Mixed Bed* ionXchanger.
(U.S. Patents 2605084 2771424)

1954 A huge 5,000 gpm fully-automatic mixed-bed ionXchanger was designed and built by IWT to remove silica from make-up water for high-pressure boilers. This plant has now de-ionized over SIXTY BILLION pounds of water.

1957 IWT introduced "Counterflow," the first really new idea in multi-bed ion-Xchangers since the introduction of silica-removal techniques. (Patent pending.)

THIS EXPERIENCE CAN MEAN A LOT TO YOU

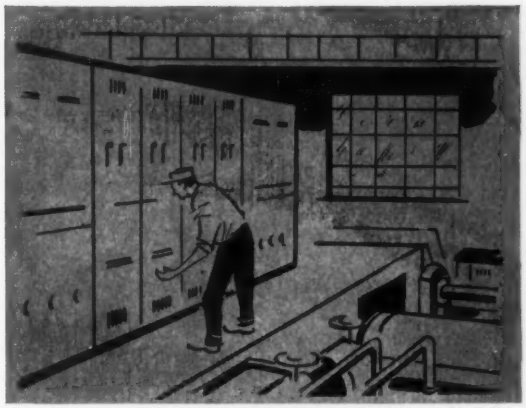
These ideas, and other IWT developments, can mean reduced costs, improved operations, and greater efficiency in your plant. *Check with your IWT representative.*

ILLINOIS WATER TREATMENT CO.
840 CEDAR ST., ROCKFORD, ILLINOIS
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

Here's why it pays to Specify Silicone Insulated Transformers

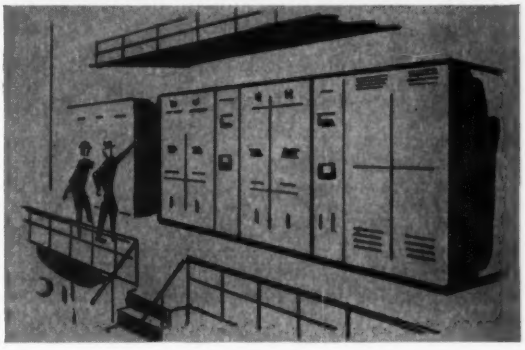
A New Level of Performance for Power Station Auxiliaries

Insulated with silicones, dry-type transformers are so completely safe, you can locate them almost anywhere. Easier and less costly to install than liquid-filled types, they require no vaults, barriers or ventilating fans. And when installed, they offer the best assurance of uninterrupted power because Dow Corning Silicones mean extra overload capacity . . . superior resistance to high ambients, moisture and contaminated atmospheres. Here's how to select the dry-type transformer most suited to your needs —



for maximum reliability, minimum maintenance

Specify a silicone-insulated *sealed* dry-type transformer. With core and coils sealed in an atmosphere of nitrogen, these units have no liquids to maintain . . . require only a periodic check of pressure gauge and bushings . . . are virtually maintenance-free.

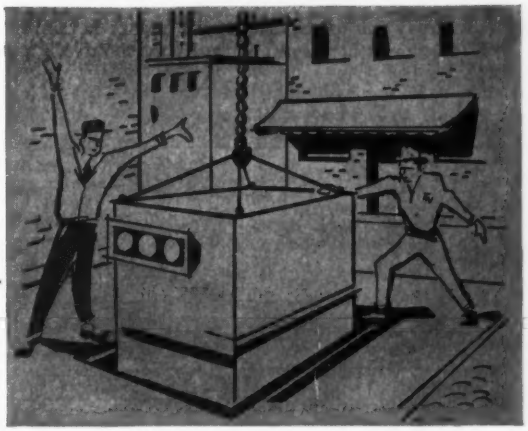


for minimum weight

Specify a silicone-insulated *open* dry-type transformer. Lighter by 15% than the next lightest type, these units are ideal for balconies and other areas where minimum floor loading is a must.

A New Level of Performance for Underground Distribution Systems

Silicone-insulated, nitrogen-filled *network* transformers require so little upkeep, they can be buried and virtually forgotten. They are undamaged even when flooded. Only the bushings, pressure gauge and case require periodic inspection. Dry-type transformers fit easily into existing vaults; are completely safe even in case of extreme overloads or short circuits.



Send today for your copy of new brochure detailing how you can save with silicone insulated dry-type transformers. Includes up-to-date list of manufacturers offering equipment insulated with Dow Corning Silicones.

Address Dept. 6919

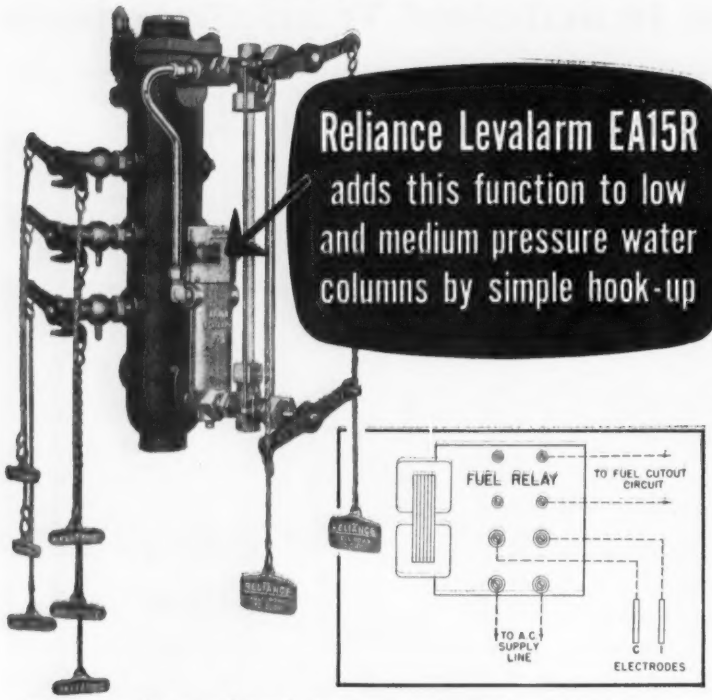
first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D. C.

For more facts circle 269 on Rader Service card, p 99

Install a fast-acting, positive fuel cut-out control at low cost


Reliance Levalarm EA15R
adds this function to low and medium pressure water columns by simple hook-up
FUEL RELAY
TO FUEL CUTOUT CIRCUIT
TO A.C. SUPPLY LINE
ELECTRODES

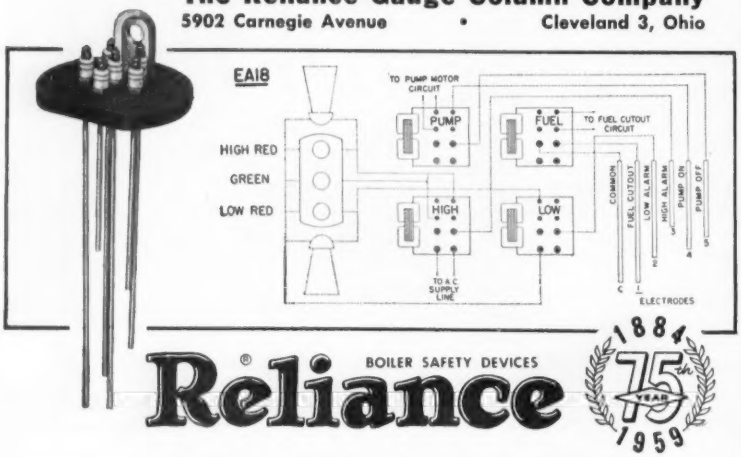
Two electrodes extend into boiler water in the Levalarm chamber. Water surrounding them completes a closed circuit carrying special current supply from a transformer. When water level drops below the electrodes, the relay circuit to the solenoid-operated fuel valve is broken. Action is immediate. An auxiliary alarm can be actuated at the same time. This Levalarm may be installed on any water column having gage centers not less than 12½"; maximum 450 psi. Very easy to install . . . Another model is designed for pressures to 900 psi.

Up to FIVE functions possible with other Levalarms

Broad protection for your boiler's safety can be realized through multiple-electrode Levalarm models that install in the water column cap. Model EA18 has enough electrodes to provide fuel cut-out, low and high water alarms, and start and stop feed pump. To comply with insurance company rulings requiring dual fuel cut-out facilities, an extra electrode can be added to the Levalarm. Thus no additional piping needed.

It will pay you to get details on Reliance Levalarms. Write for Bulletin D2 or contact nearest Reliance Representative.

The Reliance Gauge Column Company
5902 Carnegie Avenue • Cleveland 3, Ohio

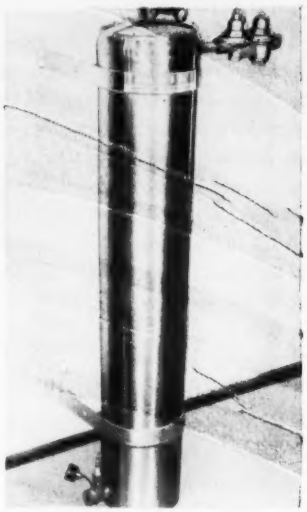


BOILER SAFETY DEVICES
Reliance
1884 75th YEAR 1959

Equipment news

Begins on page 112

est where dust particles are finest. Resistance is low: 0.1-in. wg at 350 fpm, 0.15-in. wg at 520 fpm, maker states. Standard sizes cost $1.80 to $2.50.—Arco Manufacturing Corp

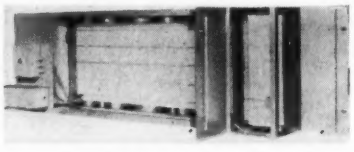


Compact deionizer

14 • Up to 120 gph of deionized water is produced by this unit. Bags of mixed ion-exchange resin are removable and when exhausted are lifted out and exchanged for factory-regenerated refills.

Stainless-steel deionizer is 45-in. high. It hooks into water supply line and furnishes demineralized water under line pressure. Unit delivers 6300 to 8400 grains exchange or up to 1500 gallons per cycle. When resistance falls below 50,000 ohms a built-in meter actuates a pilot signal. —Elgin Softener Corporation

Just circle key numbers on the Reader Service card, page 99, to get complete product story



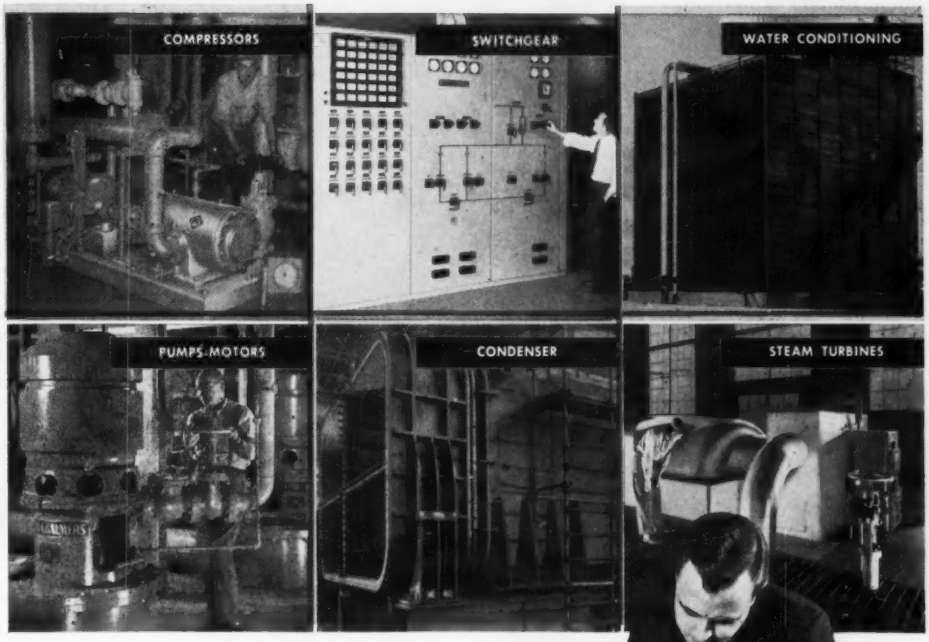
Horizontal air filter

13 • *Type H* filter features automatic renewable media, automatic operation. A minimum of maintenance will keep it going, and filter resistance is constant, maker states.

Renewable media is a woven curtain of glass fibers. Horizontal de-

In pace with POWER... ALLIS-CHALMERS

ALLIS-CHALMERS



ONE MAN...

Your Allis-Chalmers man... can supply and coordinate all this equipment and more

Compressors, switchgear, condensers, steam turbines, motors, pumps and water conditioning equipment — Allis-Chalmers builds them all.

But equipment is not the whole story. You get more, much more than fine equipment when you specify Allis-Chalmers.

- There's the obvious time- and money-saving advantage of single-source buying.
- The coordination of drive to driven part.
- The coordination of engineering and delivery.
- The unit responsibility for equipment in service.

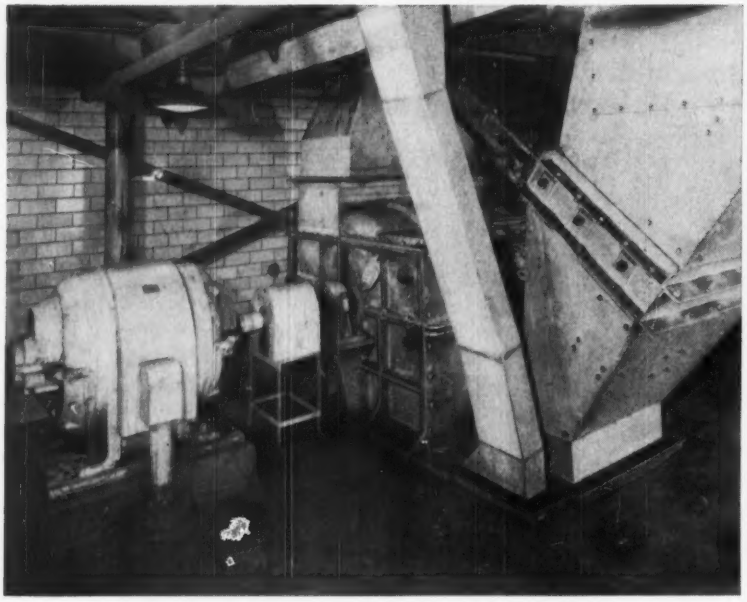
Whatever your power equipment problem may be... there's one man to call — your nearby A-C engineer. His recommendations are backed by experts on the particular equipment involved. *Allis-Chalmers, Milwaukee 1, Wisconsin.*

Plan to stay ahead... MODERNIZE!

A-5991-PR

ALLIS-CHALMERS

CRUSHING FACTS



American "Rolling Ring" Coal Crusher

splits coal . . . smashes maintenance costs!

In almost five years, the above American Coal Crusher has reduced 1,800,000 tons of 2" x 0" coal to a ¾" x 0" product for a prominent midwestern utility. Since installation, this unit has handled an average annual tonnage of 450,000, with a very low ratio of replacement parts to tonnage. The operating engineer for this utility says, "We have experienced no stoppages . . . crusher operation and maintenance have been very satisfactory."

"Rolling Ring" design makes the difference. Specially designed rotor, consisting of four rows of patented shredder rings, each suspended on a single shaft, rotate freely at a relatively *slow speed*. Coal is *split* rather than smashed. This splitting action saves both power and maintenance, gives more uniform sizing, fewer fines. Rings can be reversed to give extended life.

American has manufactured reduction equipment since 1908 and you can be sure that "When you figure costs, the best results come from American *Rolling Ring* Crushers." If you have a coal preparation problem, why not write today for recommendations and literature. Our highly-trained engineering staff will give you prompt assistance.

American PULVERIZER COMPANY

DISTRIBUTORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

1349 MACKLIND AVE. ST. LOUIS 10, MO.

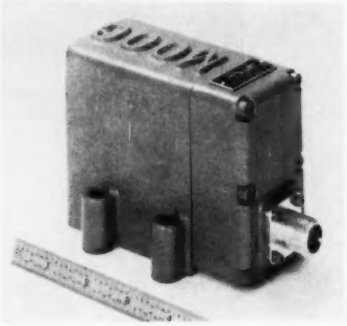
Equipment news

Begins on page 112

sign can be used on existing or new multizone air-conditioning units, heating and ventilating units, industrial heaters. It's also useful where headroom is limited.

Ten sizes cover 4070 to 39,000 cfm.—American Air Filter Co

Just circle key numbers on the Reader Service card, page 99, to get complete product story



Flow-control servovalve

26 • Designed specifically for industrial hydraulic-control systems, *Series 71* valve operates on the 2-stage force-balance feedback principle, with large field-replaceable filter integral in a cast Meehanite body.

Standard connector or terminal box accommodates the electrical input. Four sizes available range from 1 to 10 gpm with 1000-psi valve drop and 20-ma input. System pressures from 500 to 4500 psi may be used. —Moog Valve Co Inc

Extruded niobium tubing

31 • Niobium has now gone into commercial production, and is available in ¼- to 1-in. dia rod, ½- to 1-in. OD tube with .085- to .020-in. wall thickness, in lengths up to 20 ft, as well as in special sizes to order.

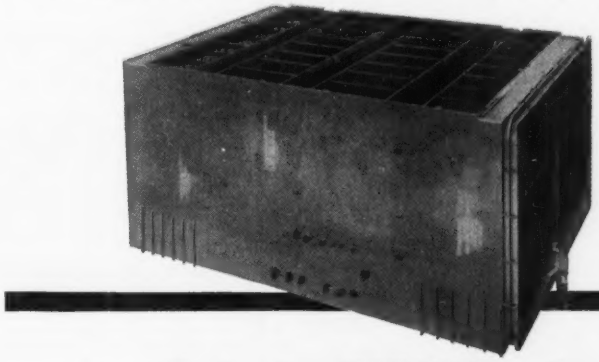
High strength at high temperatures makes niobium a valuable atomic-plant material. In the past, impurities in the metal prevented successful extrusion.—Calumet & Hecla, Inc, Wolverine Tube Div

Steel check valves

46 • High-temperature hot-water service is provided by new valves. When forward flow stops spring-actuated unit closes automatically, elim-

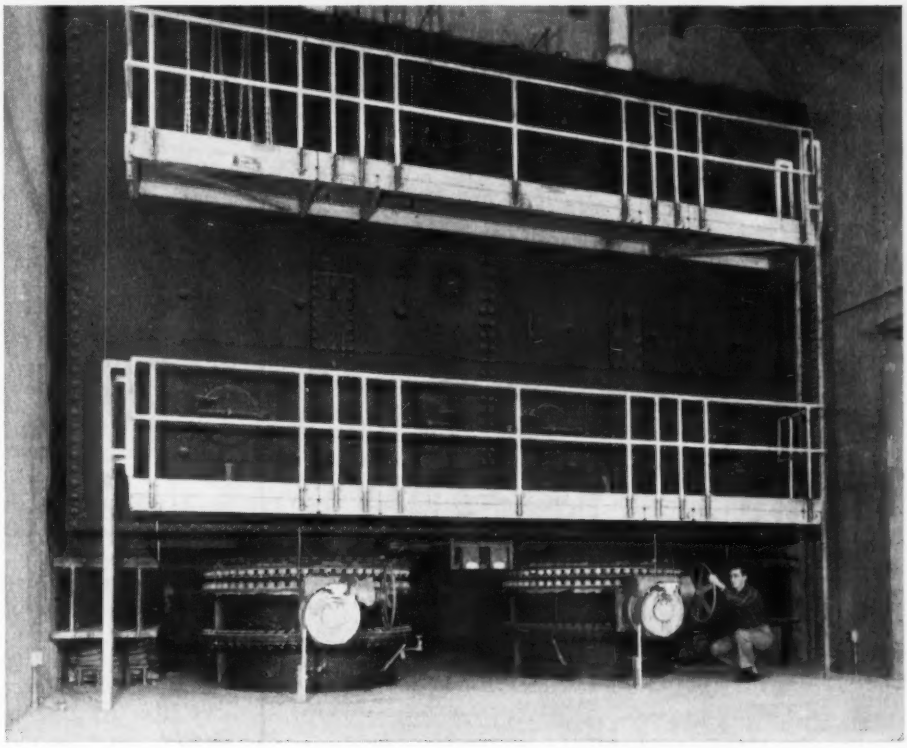
ALLIS-CHALMERS

In pace with POWER... ALLIS-CHALMERS



Plan to stay ahead... MODERNIZE!

Today's BIGGEST Condenser



200,000-square-foot condenser now in operation at Fisk Station of Commonwealth Edison

Some man-sized problems were presented by this unit... not the least of which were shipping and erection. Special Allis-Chalmers well-center cars permitted shipment of the entire shell in only four sections. Special alignment techniques developed by A-C cut installation time.

Today it serves a 327-mw Allis-Chalmers steam turbine generator. Note the compact, space saving rectangular shape pioneered by Allis-Chalmers and made practical by the A-C guided-flow condenser design.

For help on your condenser problems, large or small, contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-1046-PR

ALLIS-CHALMERS

More clean water at a lower cost with
S.P. KINNEY AUTOMATIC SELF-CLEANING
STRAINERS
. . . for efficient removal and disposal of suspended particles from raw or process water and other liquids

✓ Over 1000 installations
✓ 2" to 48" pipeline sizes
✓ Installation on pressure or suction side of pump

Write today for Bulletin 500.1P

S. P. KINNEY ENGINEERS, Inc.
CARNEGIE, PENNSYLVANIA

circle 274 on Reader Service card, p 99

Snapit-On
Protector Shields for CONDENSER AND BOILER TUBES

DETERS EROSION
PREVENTS MATERIAL WASTAGE
REDUCES MAINTENANCE
GIVES TUBES LONGER LIFE
MADE IN STAINLESS STEEL AVAILABLE IN ALL SIZES

The Vince BASNIK COMPANY
2070 CENTER STREET • CLEVELAND 13, OHIO

circle 275 on Reader Service card, p 99

7 big reasons why A. O. Smith *Permaglas*® glass-protected (inside and out) smokestacks are your best investment

1 3 to 5 times longer life than unlined steel stacks
2 corrosion resistance regardless of excess condensate
3 low maintenance — glass can't rust
4 lightweight — lower foundation cost
5 lower cost — glass protection now within reach of all
6 tough, durable — remarkable resistance to impact or abrasion
7 easy to install — no need for special equipment or highly skilled workmen

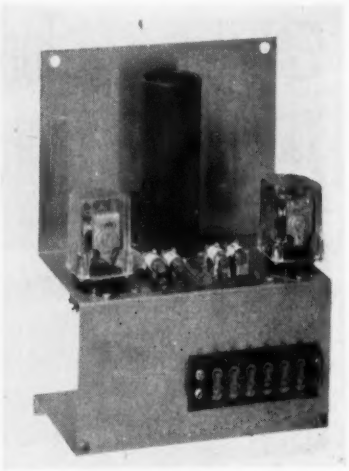
Write Dept. P-79 for the Remarkable Facts!

Through research ... a better way
A.O.Smith CORPORATION

PERMAGLAS SMOKESTACK SALES
PROCESS EQUIPMENT DIVISION
MILWAUKEE 1, WISCONSIN

inating surge, hammer and backdrop. Units work at all fluid temperatures and have pressure ratings from 150 to 2500 psi.

Valves can be installed in any position. They have a large flow area in excess of pipe diameter, reducing fluid velocity across valve seat and cutting head loss. Disk is center guided above and below for balanced lift.—Combination Pump Valve Co



Gas-valve shutoff delay

47 • Delay units prevent gas valves from closing during momentary periods of voltage drop. In case of power fluctuation or failure due to thunderstorms or power changeover, units keep fuel shut-off valves open for five seconds. This eliminates resetting, keeps production on schedule. *Model A* works on 440-, 220- or 110-volt 60-cycle current; *Model B* has an additional interlock for use with other types of safety devices; *Model C* is for use with flame-safety controls.—Michigan Controls Co

Just circle key numbers on the Reader Service card, page 99, to get complete product story

Metal-to-metal seal

28 • Metal-to-metal seal handles applications involving critical and varying degrees of pressure, flow and temperature. Assembly is applicable to all types of valves, has been successfully tested as a pilot-operated shutoff valve with 10,000-psi nitrogen and as a check valve with gases,

ALLIS-CHALMERS

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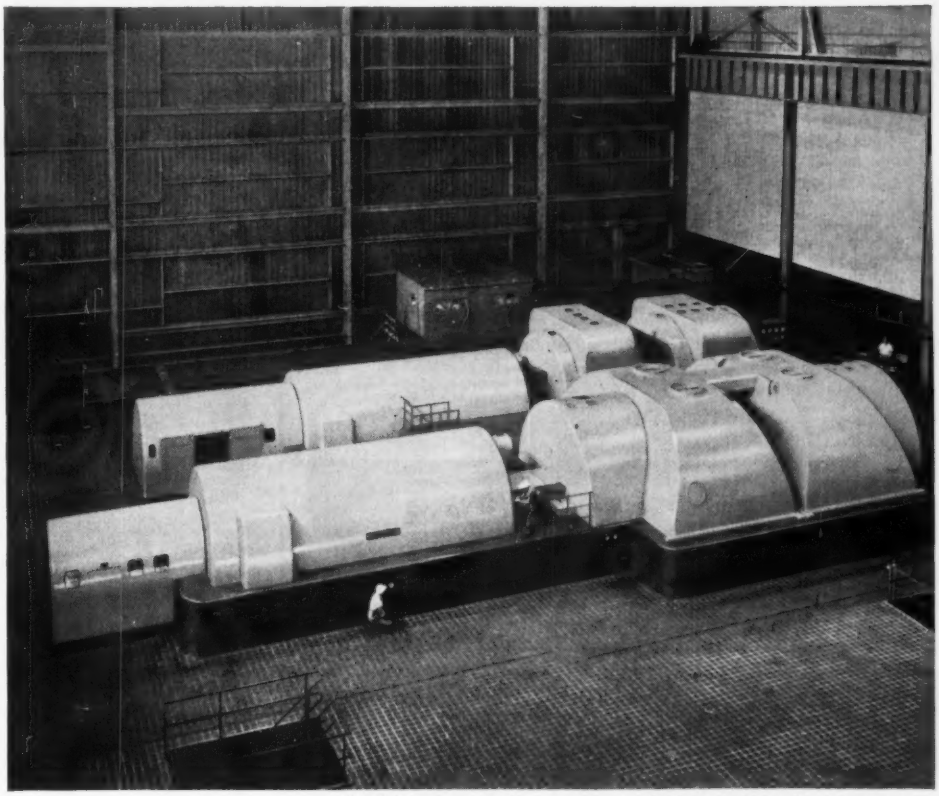

321,500-kw, close-coupled, cross-compound reheat design with two generators... one on 3600-rpm shaft... and one on 1800-rpm shaft. Steam conditions: 2400 psig, 1050 F at inlet; 1000 F reheat; 1 inch Hg absolute exhaust pressure.

Detroit Edison's new 321,500-kw machine goes on the line

River Rouge Unit 3 increases the capacity of the Detroit Edison system to 3¼ million kilowatts — double its capacity of 10 years ago.

In size, in design, this steam turbine-generator unit was the beginning of a new era in power generation.

Of special interest are the record size 46-inch exhaust blades; and the close-coupled arrangement with the crossunder piping located above the foundation which made it possible to build to compact over-all dimensions.

For an interesting discussion of this turbine, see ASME paper 58-SA-22 . . . available through your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Plan to stay ahead. MODERNIZE!

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For more facts circle 278 on Reader Service card, p 99

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COMPAK
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Steel Firebox Heating & Power Boilers
Low & High Pressure Water Tube Package Boilers • International-LaMont Forced Recirculation Generators • ASME Code Pressure Vessels & Welded Products.

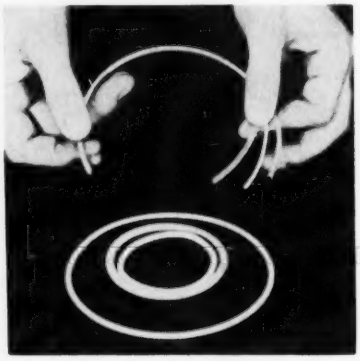
930 Spruce St. East Stroudsburg, Pa.

Equipment news

Begins on page 112

hydraulic oils, fuels at temperatures from –20 to 650 F, according to the manufacturer.

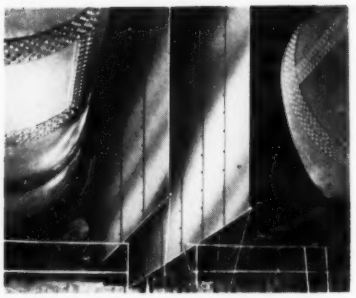
Members are designed so that small pressures will deflect any irregularity, give complete seal between seat and poppet without need for rubber or synthetic seal aids.—Hydraulic Mechanisms, Inc



Silicone O ring

17 • Extreme chemical resistance, low coefficient of friction, good thermal characteristics, good resistance to extrusion and low compression set permit operation under varied service conditions. Units are used at temperatures up to 300 F, with linear expansion of 0.01 in. per inch. Unit has a good "memory" at temperatures below 30 and above 200 F. —Fluoro-Plastics, Inc

Just circle key numbers on the Reader Service card, page 99, to get complete product story



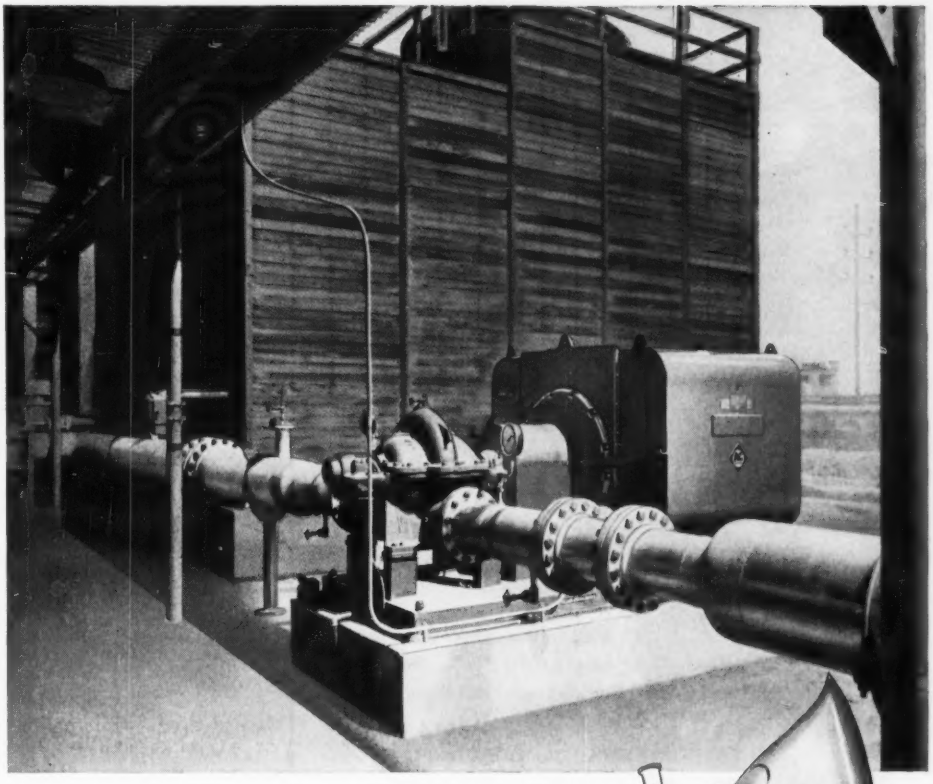
Protective heat cloth

38 • Aluminum sheet foil is laminated on glass-cloth fabric to protect personnel by reflecting radiant heat as a mirror reflects light. Cloth is flexible and easy to use as curtain, shield or panel. It should speed up

For more facts circle 279 on Reader Service card, p 99

ALLIS-CHALMERS

In pace with POWER... **ALLIS-CHALMERS**



CONTROL ALGAE

easy, low-cost way

Eliminate problems of plugged pump strainers, coated heat-exchanger tubes and coated slots in cooling towers.

Control is safe . . . quick with Allis-Chalmers No. 120 Series Algaecide.

This algaecide is toxic to more algae than any other. On the other hand, it has low toxicity to fish or animals and is extremely safe to handle. Even in concentrated form it is only a mild irritant to skin and hands.

A little goes a long way! Only 2 to 5 ppm are required for effective dosage of most organisms. It's easy to feed into the system . . . and is non-oxidizing and corrosion inhibiting.

No water conditioning specialist needed to use it! Buy it and try it. Purchase directly from your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5972-PR

ALLIS-CHALMERS

New RIDGID® No. E-110 Offset Hex Wrench

Maximum jaw opening across flats, 2⅜"... handles up through 1½" drain nuts.

Extra-wide Jaw Opening . . . Short Handle make work easy on sink and tub drain nuts!

Here's a real time saver. This latest addition to the RIDGID Hex Wrench line is especially designed with an extra-large opening offset jaw that gives easy-on, non-slip grip on sink and tub drain nuts . . . all other hard-to-get-at nuts and fittings. Thin, smooth jaws slip into tightest places . . . won't mar highest chrome finish. Short handle makes work easy in close quarters. Multi-sided grip allows extra leverage . . . no more rounded nut shoulders or bruised knuckles.

Famous heavy-duty RIDGID construction. Alloy malleable housing guaranteed against warping or breaking. Comfort-grip handle has handy hang-up hole.

Save time on every job . . . order your RIDGID No. E-110 Hex Wrench from your Supply House!

RIDGID®

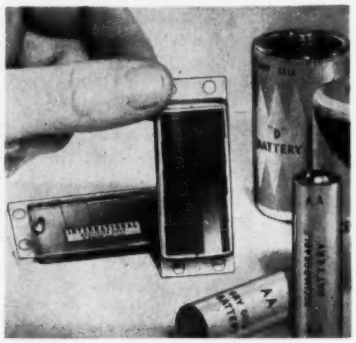
The Ridge Tool Company, Elyria, Ohio, U.S.A.

Equipment news

Begins on page 112

time on regular maintenance jobs and reduce downtime on more serious repair jobs.—Frommelt Industries

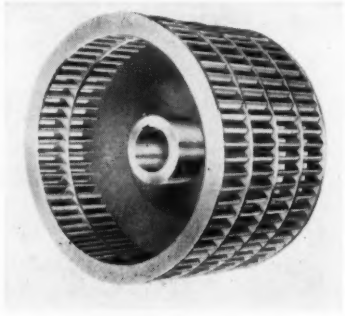
Just circle key numbers on the Reader Service card, page 99, to get complete product story



Silicon solar-cell batteries

20 • High-efficiency units are said to give same power output as dry-cell and mercury-cell batteries. They power transistorized equipment during daylight and charge storage batteries for continuous day and night operation.

Output of the solar module is 1.75 v at 30-C cell temperature and 1.5-v dc at 65 C.—International Rectifier Corporation



Mechanical-draft fans

23 • Forward-curved mechanical-draft fans with many blades provide a high air-movement to size ratio, manufacturer states. All blades are made of mild or alloy steel.

Rotors, above, operate at low peripheral speed. Streamline inlets direct the air into the rotor with minimum turbulence and big inlet boxes reduce entering velocity to further cut noise, according to the maker.—Chicago Blower Corporation

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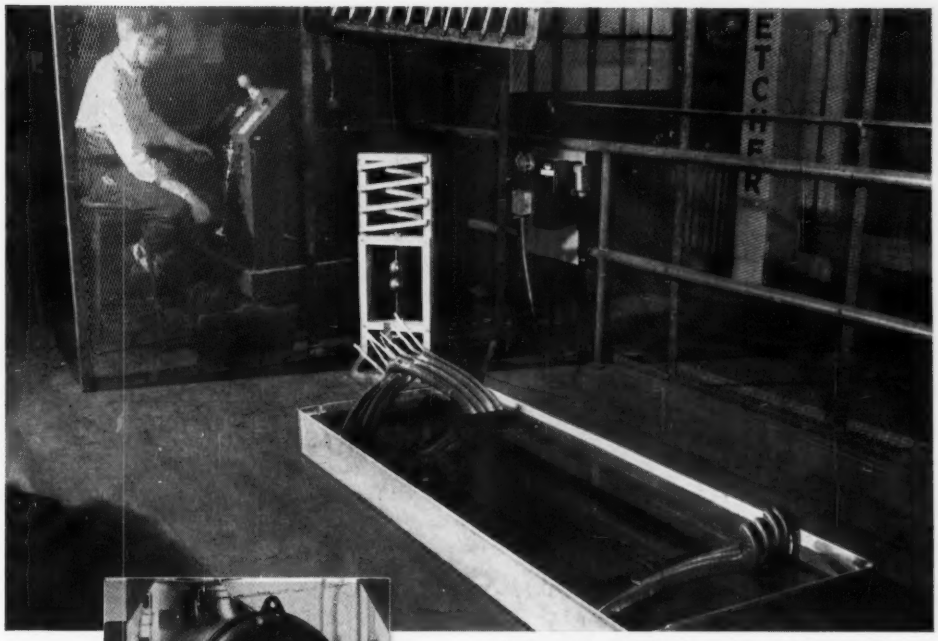

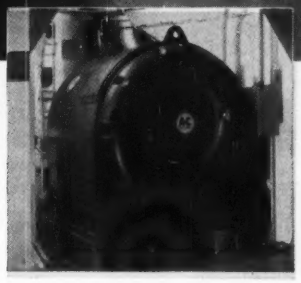

Moisture-resistant *Silco-Flex* coils are high-potential-tested under water, with test voltage applied for one minute between conductor and water bath.

Super-Seal coil foils water

"Hi-pot" tests under water prove moisture resistance

Remarkable insulation systems combined with advanced mechanical features provide a completely new concept in motor protection — the *Super-Seal* motor. This motor gives you complete protection from moisture, fly ash, and other contaminants, even with so-called drip-proof motor enclosures.

New motor is protected with *Silco-Flex* stator coil insulating system: A homogeneous, void-free dielectric barrier of vulcanized silicone rubber so moisture-proof it can be hi-potted under water, cleaned by hosing down. Resists most corrosive or chemical atmospheres.

Integrated field coils in synchronous machines are completely sealed against contaminants, bonded and locked against mechanical forces.

For additional information, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Super-Seal and Silco-Flex are Allis-Chalmers trademarks.

Plan to stay ahead... MODERNIZE!

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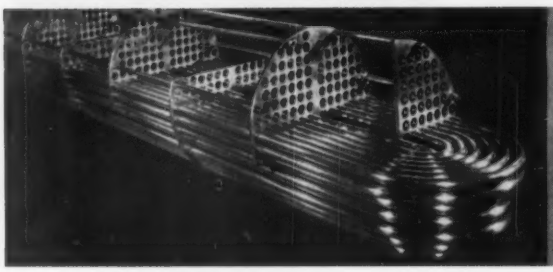


CONDENSER AND HEAT EXCHANGER CLINIC

Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Buffalo 5, New York

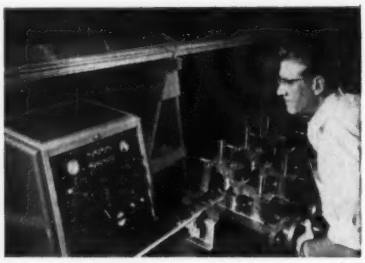
New controls and services meet increasingly critical requirements in heat-transfer units

As steam cycles in turbines become more complex—and operating temperatures and pressures rise—the job of the heat-transfer equipment becomes increasingly critical. Nuclear energy plants place tremendous emphasis on continuity of service for even conventional components like condensers. And in many processing plants the cost of shutdowns may range from exorbitant to disastrous.

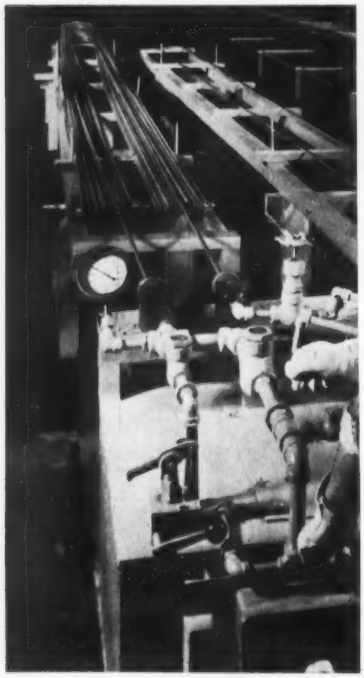
Assurance that tubes will meet service requirements becomes increasingly important. And The American Brass Company has augmented its normal quality controls with tests and services to help makers of heat transfer equipment prevent possible trouble before it starts.

Electronic inspection. All tubes are inspected visually one at a time, both internally and externally. However, where greater assurance is required, the tubes—in straight lengths up to 100′—can be inspected electronically by eddy-current equipment.

All tubes are inspected visually one at a time, both externally and internally.



When required, tubes are inspected by eddy-current equipment, located at the tube straightener.



All U-bend tubes are tested hydrostatically at ASME Code pressures—or higher, if necessary.

Hydrostatic testing. As most U-bend tubes are used in applications involving high temperatures and pressures, all of these tubes are tested hydrostatically—after bending—at ASTM Specification pressures. They can, however, be tested at ASME Code pressures, up to 6000 psi, on request, if the tube size is such that it will withstand the pressure.

Relieving stresses. All U-bend tubes, other than copper, are annealed at the bend area after bending, to eliminate the hazard of stress-corrosion cracking which might occur in service due to stresses that may exist as a result of the bending.

Duplex tubes are widely used in chemical plants and petroleum refineries to meet diverse combinations of corrosive action and/or pressure and temperature. Recently designers have selected them for use in air-removal sections of electric-power-plant condensers where corrosion is very severe.

Broadest service. In helping manufacturers and users of heat-transfer equipment meet day-to-day problems, The American Brass Company has a broad background in the latest developments in heat-transfer equipment's expanding role. And with new mill equipment now in place, it offers the broadest service available in tubes for heat-transfer equipment. For technical assistance in special problems, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5958 Rev.

ANACONDA®

TUBES AND PLATES FOR CONDENSERS and HEAT EXCHANGERS

Made by

THE AMERICAN BRASS COMPANY

A new development by Iron Fireman

WhirlBlast

DUAL-FUEL BURNER

FORCED DRAFT... no stack draft required
DUAL FUEL... gas or oil — instant changeover
CLEAN... no air pollution
PACKAGED... everything built-in, ready to go

New high in combustion efficiency and fuel economy

with this revolutionary burner for medium size boilers

This compact Iron Fireman WhirlBlast unit combines many of the advantages of big burners, yet it requires little more supervision than the oil or gas burner in your home.

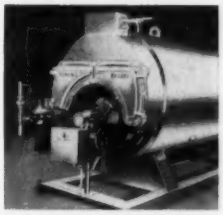
No stack — no draft problems. Air supply is precisely controlled under all conditions. The WhirlBlast burner eliminates the need for a costly and unsightly smokestack, and also eliminates the noise, bulk and high power requirements of induced draft firing. This burner starts clean and burns clean, with no soot or smoke problems.

Steadiest flame ever developed. In the new WhirlBlast firing head Iron Fireman engineers have solved the persistent problem of flame pulsation. A clean, steady, efficient flame is achieved without firebox vents or any other makeshift device.

Fires gas or light oil; changes fuels instantly. Quick fuel changeover can be accomplished with the flick of a switch, or automatically with special controls. Models available for firing either gas or oil exclusively.

A true "package". When you bolt the WhirlBlast unit to the boiler front you install a complete forced draft firing system, combining air and fuel systems and integral electronic combustion controls. It leaves the factory as an operating unit, factory wired and tested. Does not require refractory combustion chamber, nor any provision for secondary air supply.

For all types of boilers. The WhirlBlast burner can be purchased in two ways: as a boiler-burner unit (shown at right), or as a burner alone for use in your present boiler.



Complete boiler-burner unit, ready to operate. Boiler and burner compose a single unit, engineered, assembled, wired and tested at the factory, carrying factory responsibility. Requires little more than service connections when delivered to the job. Sizes from 15 to 100 boiler horsepower.

Send for more information

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT FOR HEATING, POWER, PROCESSING

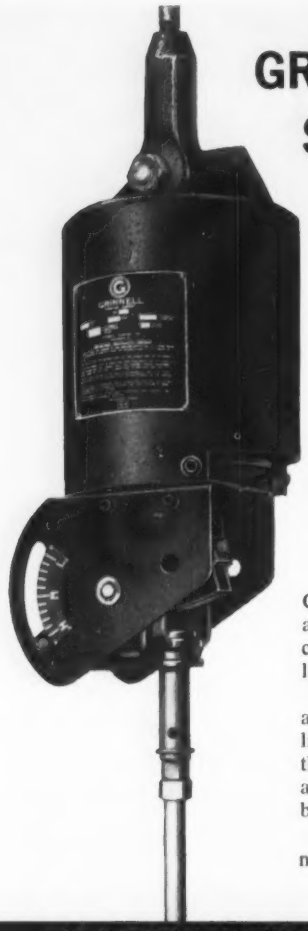
IRON FIREMAN MANUFACTURING CO.
3132 W. 106th Street, Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send me more information and specifications on the Iron Fireman WhirlBlast burner.

Name_____
Firm_____
Address_____
City_____ Zone_____ State_____

For more facts circle 284 on Reader Service card, p 99

GRINNELL CONSTANT SUPPORTS...



2 BASIC DESIGNS...

11 DIFFERENT METHODS OF ATTACHMENT

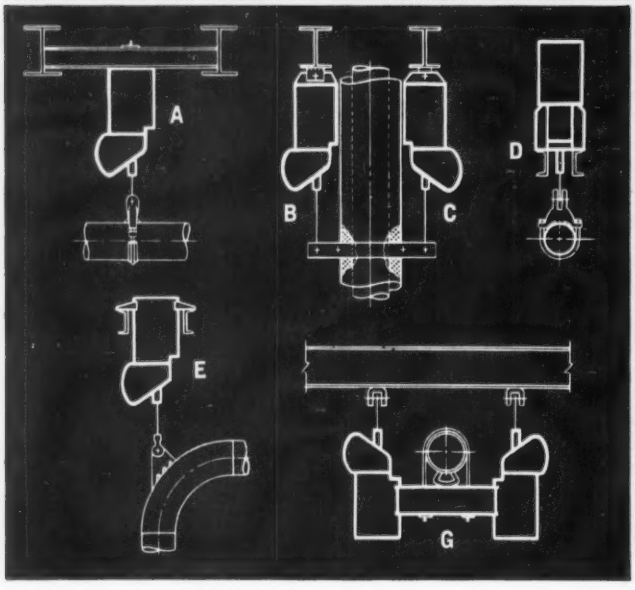
Grinnell Constant Supports are available in a range of sizes to provide capacities for loads from 27 lbs. to 57,500 lbs., with travels up to 16 inches.

Both vertical and horizontal hangers are designed to operate in extremely limited space. In the selection of types, there is a choice of 11 methods of attachment to structures—either above, between, or below supporting steel.

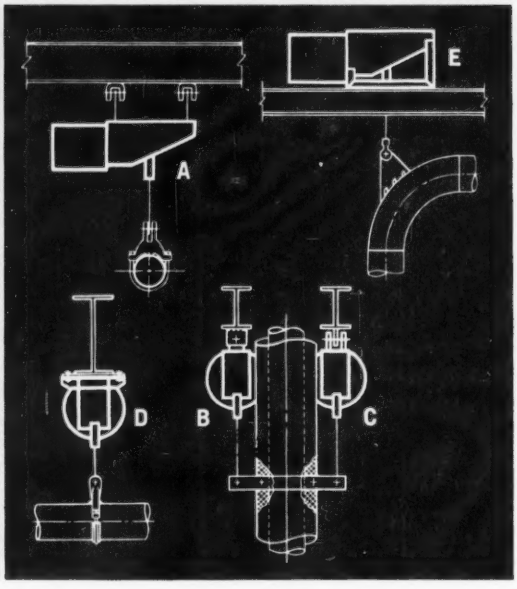
Grinnell Constant Supports provide mathematically perfect load support throughout all positions of travel . . . also a full 70 percentage points of adjustability is built into them. No less than 10% of this adjustability is allowed either side of calibration for plus or minus change in load. Field readjustments are easily made by turning a single load adjustment bolt.

Call on Grinnell's Pipe Suspension Department for help with your pipe suspension problems. Grinnell Company, Providence 1, Rhode Island.

FOR VERTICAL ATTACHMENT



FOR HORIZONTAL ATTACHMENT



GRINNELL

AMERICA'S No. 1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

For more facts circle 285 on Reader Service card, p 99

Hall Industrial Water Report

VOLUME 7 JULY 1959 NUMBER 4

More International Trouble

Industrial water problems know no geographical boundaries. They are as prevalent and troublesome in Europe and Asia as they are in North or South America. And, no matter where they arise, they require expert handling. This is why calls for Hall Laboratories services come from all over the world. Hall engineers are able to solve some of the problems by correspondence, but travel halfway around the world to tackle others on the spot.

The problems themselves are no different because they occur in Saudi Arabia or Chile. Each offers its unique combination of factors, and the Hall engineer uses his training and experience to decide what is significant and what practical steps must be taken.

Power for India

Water conditioning for a 150-megawatt power station in India was started more than five years ago and successfully controlled entirely through correspondence.

When the high-pressure unit was ready for operation, Hall engineers had already set up a complete program of water and steam conditioning to avoid water-connected trouble in any part of the station. They established the chemical conditions to be maintained in water throughout the plant. They specified the analytical procedures and equipment required for control, the necessary conditioning chemicals and how to feed them. They outlined in detail the mechanics of operating the clarifying and zeolite softening equipment for treating evaporator feedwater.

The operators carried out the program to the letter. Progress was followed through water conditioning reports and analysis of water samples submitted on a fixed schedule.

One problem did occur. Scale composed of mica and iron oxide was found in several water wall tubes of one boiler the first time it was inspected. Investigation revealed that the mica came from mud which got into the tubes before they were installed. Furthermore, these tubes had been damaged in transit; repair by welding and heating with blow lamps produced some iron oxide.

The general superintendent of the plant wrote to Hall Laboratories, "I wish to take this opportunity to thank you for the valuable help you have rendered us during the initial operation of this power station."

Costly Boiler Outages

Deposits caused numerous annoying and costly tube failures in the 625-psig boilers generating steam for power and process at an oil company installation in Arabia. Analysis showed the deposits to be composed principally of iron oxide but to contain significant amounts of magnesium phosphate.

Hall engineer A. M. Henricks made a complete survey of the plant. He established the source of the iron oxide to be corrosion in the condensate system. He recommended the use of a filming amine (Hagafilm®). This effectively reduced accumulation of iron oxide in the boilers. Test specimens showed a reduction in corrosion rate of about 90%.

The magnesium was traced to evaporator carryover. Changes in internal baffling and increased blowdown to hold evaporator water solids at a lower level effectively reduced the carryover.

Five years have passed. Boiler deposits are not a problem and tube failures no longer occur.

Superheater Tube Corrosion

Operators of a utility plant in Jamaica were surprised to find active pitting in the inlet and outlet superheater headers of a boiler which had been in service for several years. Their surprise was natural because recommended water conditions had been continuously maintained both when the boiler was operating and when it was idle.

The nature and location of the corrosion convinced the Hall engineer assigned to the job that the pitting had occurred when the boiler was idle. He discovered that when the boiler was prepared for wet standby, the water was properly treated but the superheater was not completely filled. This left the superheater headers full of moist air—an ideal condition for corrosion.

The headers were thoroughly cleaned and changes were made to insure complete filling during idle periods. After more than two years there has been no further attack.

Globe Trotters

Hall service is available through thirty-five local offices in the United States, Mexico and Canada. Consultation and service on water problems take Hall engineers to many other parts of the globe. Regular trips are made to Colombia, Venezuela, Haiti, Dominican Republic, Puerto Rico, Jamaica, Newfoundland and Cuba. Occasional visits are made to such faraway places as Saudi Arabia, England, Italy and Pakistan. And plants in some other countries like Chile, Argentina, Brazil, France and India have been successfully helped with their water problems by correspondence only.

Let us know if we can help you make water behave properly in your foreign installations.

Water is your industry's most important raw material. Use it wisely.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

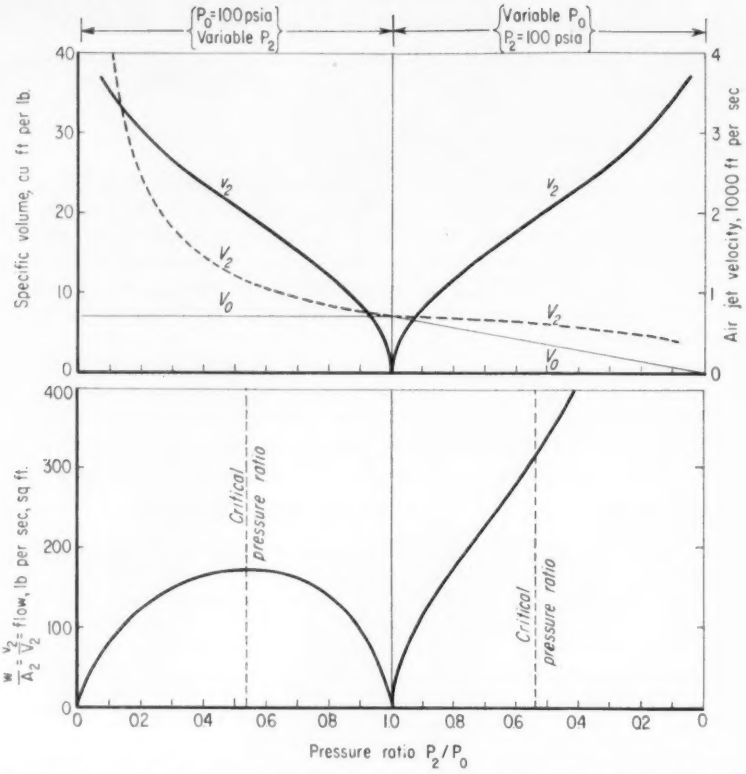
HALL LABORATORIES
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more facts circle 286 on Reader Service card, p 99

By B G A SKROTZKI
Associate Editor

The mass of bouncing molecules we know as a hot gas acts in special ways as it streams through a hole from a high-pressure source to a lower-pressure region. Starting with easy-to-understand thermo relationships, we find that departing from specified conditions makes . . .



1 Graphs *left* show property variations as pressure ratio rises from 0 to 1.0 with variable P_2; graphs *right* give data for 1.0 to 0 ratios with variable inlet P_0

Nozzle hot-gas flows go into shock

Last month we learned how properties of a gas vary as it flows through a nozzle from a higher- to a lower-pressure region. To handle a constant flow rate the nozzle cross-sectional area varied along its length, diminishing for pressure ratios from 1.0 to critical and then expanding for pressure ratios less than critical.

In an actual nozzle with given inlet and outlet conditions we found that the cross-sectional area fixes the properties of the gas at that section. In addition the pressure ratio at the section determines the velocity of the gas flowing through that section. Now we'll go one step further and find how pressure ratio and area control *mass rate of flow* of a gas through a nozzle. We use same basic equations as last month:

$$w = A_2 v_2 / V_2 \qquad (1)$$

where w = gas flow, lb per sec; A_2 = nozzle sectional area, sq ft; v_2 = gas velocity, ft per sec; V_2 = gas specific volume at section, cu ft per lb.

For constant-entropy gas expansion from stagnation:

$$V_2/V_o = (P_o/P_2)^{1/k} \qquad (2)$$

where V_o = gas specific volume for stagnation at nozzle inlet, cu ft per lb; P_o = stagnation pressure at nozzle inlet, psfa; V_2 = gas specific volume at section, cu ft per lb; P_2 = gas pressure at nozzle section, psfa; k = ratio of specific heats.

Last month we derived the equation for gas velocity:

$$v_2 = 223.8 \sqrt{c_p T_o \left[1 - (P_2/P_o)^{(k-1)/k}\right]} \qquad (3)$$

With these in hand let us transpose Eq (1) to get:

$$w/A_2 = v_2/V_2 \qquad (4)$$

This gives us ratio of lb per sec flow per sq ft of nozzle area. We get the right-hand side from Eq (2) and (3).

To get a broader understanding of nozzle behavior we'll study two sets of conditions. In the first we'll place a nozzle to take air at 100 psia and 1900 °R as constant *inlet* conditions. We'll vary exhaust from 0 psia to 100 psia to vary pressure ratio P_2/P_o from 0 to 1.0. When at 1.0 pressure ratio we'll keep *exhaust* pressure constant at 100 psia and raise inlet pressure to vary pressure ratio from 1.0 to 0, keeping inlet temperature T_o = 1900 °R.

Table lists the properties calculated for the given pressure ratios with aid of Eq (1) through (4), for the

Theoretical nozzle performance

Air flow = 1.0 lb per sec; $T_o = 1900$ °R;
$k = 1.33$; $c_p = 0.28$; $R = 54.1$

P_2/P_0	P_o psia	P_2 psia	V_o cu ft/lb	V_2 cu ft/lb	v_2 ft/sec	$\frac{w}{A} = \frac{v_2}{V_2}$ lb/sec, sq ft
0.1	100	10	7.15	40.4	3415	84.6
0.2	100	20	7.15	23.98	2967	123.7
0.3	100	30	7.15	17.68	2625	148.5
0.4	100	40	7.15	14.24	2333	163.8
0.54	100	54	7.15	11.37	1945	171.2
0.6	100	60	7.15	10.49	1783	170.0
0.7	100	70	7.15	9.35	1503	160.8
0.8	100	80	7.15	8.46	1203	142.3
0.9	100	90	7.15	7.74	832	107.5
1.0	100	100	7.15	7.15	0	0
0.9	111.1	100	6.43	6.96	832	119.7
0.8	125	100	5.71	6.75	1203	178.3
0.7	143	100	5.00	6.54	1503	230
0.6	168	100	4.25	6.24	1783	286
0.5	200	100	3.57	6.01	1055	342
0.4	250	100	2.857	5.70	2333	409
0.3	333.3	100	2.142	5.30	2625	495
0.2	500	100	1.428	4.80	2967	619
0.1	1000	100	0.715	4.04	3415	846

two nozzle operating conditions. Fig. 1 shows the variations listed in the table. Graphs for the two conditions are really separate units, but joined at 1.0 pressure ratio to emphasize the difference in behavior for the two methods of operation.

Variable backpressure. Last month we discovered the variation in v_2 and V_2 for variable backpressure operation. The flow per unit nozzle sectional area w/A_2 rises from zero at zero pressure ratio to a maximum at critical pressure ratio and then drops to 0 at 1.0 pressure ratio. This curve has to be interpreted carefully—a hasty conclusion might lead us to the absurd condition that nozzle flow is zero at zero pressure ratio.

We also learned that we need a converging-diverging nozzle between 0 and 0.54 (critical) pressure ratio. Between 0.54 and 1.0 pressure ratio we need a converging nozzle. In the converging nozzle the exit section has the smallest area; this area will control mass flow of gas through the nozzle. If we take a nozzle with an exit area A_2 of 0.01 sq ft we would get the following mass flows for conditions in the table:

P_2/P_o	w/A_2	*Lb per sec*
1.0	0	0
0.9	107.5	1.075
0.7	160.8	1.608
0.54	171.2	1.712

For pressure ratios less than critical we need a converging-diverging nozzle that has a minimum throat area. This throat area controls mass flow rate of gas passing through the nozzle. For overall pressure ratios less than critical we'll find the *critical pressure always at the throat.* (If we use a converging nozzle in this range the critical pressure will establish itself at the exit section.) The w/A_2 curve in the lower-pressure range then aids in finding the exit area needed for the nozzle.

For any pressure ratio we first find the flow based on the throat area; knowing the flow we divide by the w/A_2 for the pressure ratio to find the exit area needed; assuming a 0.01-sq-ft throat:

P_2/P_o	*Throat* w/A_2	*Flow Lb per sec*	*Exit* w/A_2	*Exit* A_2
0.54	171.2	1.712	171.2	0.01000
0.4	171.2	1.712	163.8	0.01045
0.2	171.2	1.712	123.7	0.01383
0.1	171.2	1.712	84.6	0.02025

Throat properties. Since throat properties control the flow through converging-diverging nozzles we find formulas for calculating them directly very useful. The critical pressure at the throat is:

$$P_t = P_o \left(\frac{2}{k+1}\right)^{k/(k-1)} \quad (5)$$

Critical temperature at the throat is:

$$T_t = 2T_o/(k-1) \quad (6)$$

Any standard thermo text gives the derivations. Theoretically the throat gas properties depend only on the stagnation properties and the ratio of specific heats.

Sonic velocity. Velocity of the gas flowing through the throat of a nozzle at pressure ratios equal to or less than critical has a special value. To find this we substitute P_t/P_o from Eq (5) into Eq (3); next substitute $T_o = (k+1)T_t/2$ from Eq (6) into Eq (3). Then remembering that $223.8 = \sqrt{2gJ}$, simplify and find:

$$v_t = \sqrt{gkRT_t} \quad (7)$$

This is also the velocity of sound in a gas at temperature T_t found from experimental evidence, see Part 24, POWER, Feb 1959, p 146. This shows that for a nozzle working at pressure ratios of critical or less, sonic velocity of the gas establishes itself at the throat, at the critical pressure ratio.

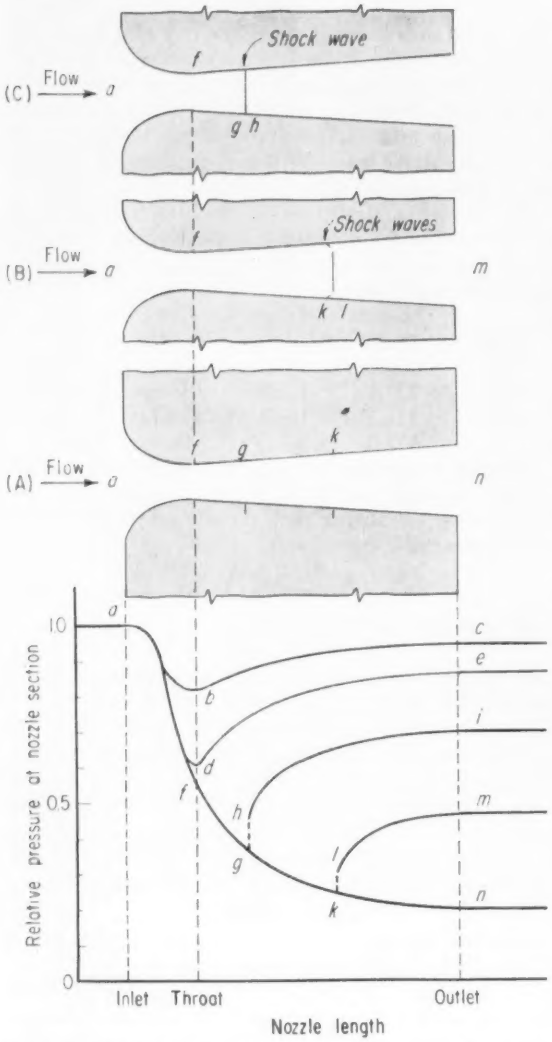
Curves of Fig. 1 show that the gas velocity v_2 is subsonic at pressure ratios more than critical and supersonic at less than critical.

Ratio of actual gas velocity to sonic velocity at given temperature is known as *Mach number, M.* So if we know velocity v of a gas at a temperature T, then:

$$M = v/\sqrt{gkRT}$$

Subsonic velocities have Mach numbers less than 1.0; sonic velocities have a Mach number of 1.0 and supersonic velocities have Mach numbers larger than 1.0. In Part 24 we learned that at ambient air temperatures ratio of molecular to sonic velocity equals 1.465. When expanding a gas through a nozzle at l-p ratios we'll usually find the exit Mach number is less than 2.0. In most power turbines and compressors Mach number runs less than 1.0.

Variable inlet pressure. Now let's study the second part of the table and Fig. 1 where we keep a constant backpressure of 100 psia on the nozzle and vary the inlet pressure from 100 psia on up to lower the pressure ratio towards zero. Fig. 1 shows the stagnation volume V_o drops proportionately to zero at zero pressure ratio. The exit specific volume V_2 also drops with pressure ratio. The



2 Nozzle designed for specific conditions has smooth static pressure variations along length *a-n*; when running at off-design conditions the pressure drop varies in many different ways

change in gas volume for this type operation is much less than for variable backpressure at the same ratios.

The interesting feature lies in behavior of ratio w/A_2, the flow in lb per sec, sq ft. For this operation the flow steadily increases with drop in pressure ratio, no maximum being reached except near zero pressure ratio. Thus we can raise gas flow through a nozzle practically proportionately by simply raising inlet pressure. Note that sonic velocity again establishes itself at the throat at critical pressure ratio. This time mass flow keeps rising because we squeeze more molecules into the nozzle inlet, shown by shrinking specific volume V_o, as pressure rises.

Nozzle static pressures. Up to this point we can see that for best operation a nozzle should be tailored to fit a specific set of conditions as given by overall pressure ratio, inlet properties, type of gas and mass flow rate needed. In actual operation a nozzle will run off design conditions some of the time and so its behavior will differ from that calculated. Let's see what happens.

Fig. 2(*A*) shows a converging-diverging nozzle built to run between pressure *a* at inlet and pressure *n* at outlet, see graph below. Experience shows that the flare of the diverging portion should be kept to about 12 deg or less. Static pressure along length of the nozzle smoothly drops to critical *f* at the throat section (where gas flows at sonic velocity, $M = 1$). As it enters diverging section pressure keeps dropping through *g* and *k* until it reaches *n* in the outlet region.

Flow through the nozzle for this design condition appears orderly without any turbulence in nozzle or at its inlet and outlet. Velocity through nozzle sections grows as pressure drops toward the outlet. The gas jet leaves at supersonic velocity, *M* greater than 1.0.

We put the nozzle into an off-design condition by raising outlet pressure to *m*. We then find that static pressure in the nozzle still drops smoothly from *a* to *f*, *g* and *k*. But at *k* pressure suddenly rises to *l* a very short distance downstream. And then it smoothly rises to *m* at the outlet. Fig. 2(*B*) shows a stationary shock wave has established itself at section *k-l*. As gas flows through the shock wave it suddenly rises in pressure and density, and its speed drops from supersonic to subsonic. Mass flow through the nozzle is not affected because this depends on the critical pressure at the throat. But exit velocity will be much lower, showing a loss in efficiency. Mass flow remains unchanged because of higher outlet density (smaller V_2).

When we raise outlet pressure to *i* the shock wave grows weaker as it moves further into nozzle at *g-h*, Fig. 2(*C*). Static pressure through the nozzle still drops smoothly from *a* to *f* and *g*. From *g* to *h* pressure rises suddenly through the shock wave at that section. Again mass flow has not been altered but exit velocity has dropped some more. After the shock wave, pressure rises smoothly from *h* to outlet pressure *i*.

As we raise outlet pressure to *e* the shock wave weakens some more, moves into the throat and then disappears. Now static pressure along the nozzle drops from *a* as before but pressure at the throat *d* is higher than critical (at *f*) for the previous conditions. There are no sudden pressure changes and no shock waves appear. Static pressure rises smoothly from the throat to outlet pressure *e*. The nozzle acts as a venturi tube for this pressure condition. Gas velocity increases from inlet to the throat sections, but does not reach sonic speed. Beyond the throat the gas velocity slows as static pressure rises to the outlet at *e*. Decreasing velocity against rising pressure is a *diffusing action*—reverse of a nozzle jet action. Velocity throughout the nozzle is subsonic, and v_2 and mass flow are considerably less than at backpressure *i*.

Raising outlet pressure to *c* raises static pressure throughout almost full length of the nozzle with a lower throat pressure at *b*. This further diminishes mass flow and nozzle exit gas velocity.

This generalized rundown shows that gas flowing through a hole does not act in a simple manner. Here, we see one of main reasons why turbines and compressors cannot work at best efficiency over their full output range. —*Next part will cover gas flow through moving buckets.*

Bridgeport Brass Admiralty tubes are the heart of the Prop-R-Temp Heat Pump of Typhoon Heat Pump Company, a Division of HUPP Corporation.

1,000 HEAT PUMPS PROVE THE DEPENDABILITY OF BRIDGEPORT TUBES

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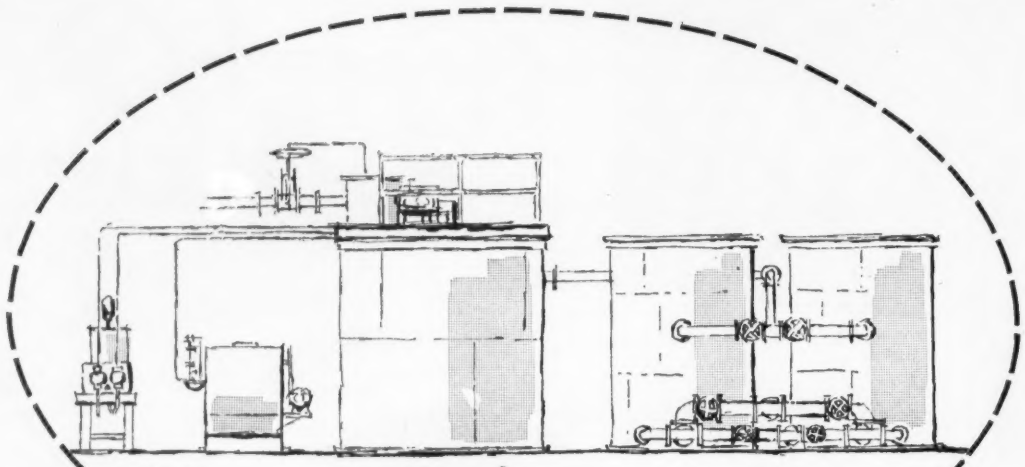

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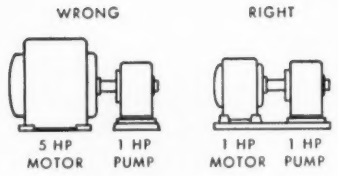
Tips on evaluating Electrical

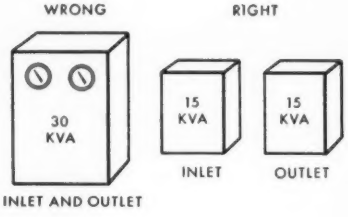
Matched Electrical Sets

You wouldn't use a 5 h.p. motor to run a pump that required only one h.p. Similarly, electrical sets should be *matched* to the requirements of the specific job. Electrical sets should be sized according to gas conditions, dust conditions, and other operating characteristics, and in accord with manufacturers' past experience on similar installations. *Don't be misled by high KVA ratings on the electrical sets.* The precipitator will only absorb a certain amount of power and the sets should be sized accordingly. A large excess of installed power, which will never be used, means inefficient use of the equipment.



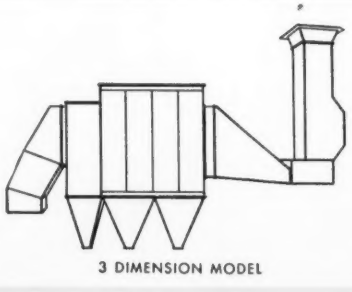
Varied Electrical Conditions

Electrical conditions in a precipitator can vary widely at different parts of the precipitator. For instance, a high voltage, low current condition usually prevails at the inlet where the dust load is high, as compared to a lower voltage higher current condition at the outlet. Consequently, it is good design (and a necessity for high efficiency) to furnish several electrical sections in series, with energization from separate electrical sets so that each section can be adjusted to best suit the conditions.



Gas Distribution

Remember that gas distribution, gas baffling, and provision against hopper sweeping all have a large influence on collection efficiency. The gas flow system should be analyzed as closely as possible, both in the precipitator and in the associated ductwork. If in doubt, have a three-dimensional gas flow study made. Two-dimensional gas flow studies *are not as accurate* and may lead to erroneous conclusions.

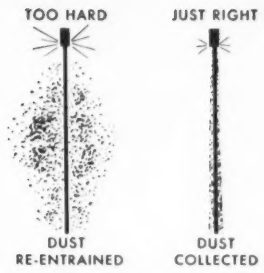


RESEARCH

RESEARCH-COTTRELL, INC. Main Office and Plant: Bound Brook, New Jersey

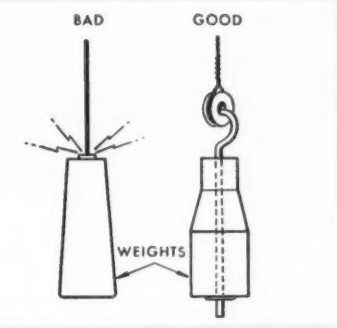
Precipitators

Some helpful hints to aid in selecting a properly designed unit



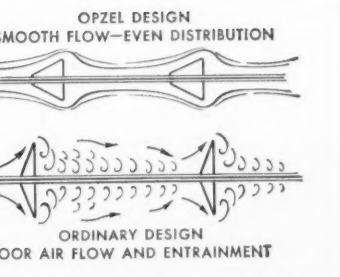
Rapping Intensity

Rappers should have easy means to vary the intensity of the blow to suit variations in operating conditions. A pre-set intensity setting cannot possibly give proper rapping over the normal range of operation. If too soft, build-up will occur which will disturb electrical conditions. If too hard, there will be reentrainment. Means of intensity adjustment are necessary to avoid drop-off of precipitator efficiency as conditions change.



Corona Discharge

It is a relatively easy matter to obtain a corona discharge in an electrostatic precipitator. Many types of discharge electrodes have been used over the past forty years, including ribbons, squares, twisted squares, star shaped sections, coiled wires, wires with prongs and projections, most of which give entirely adequate corona conditions. Final choice then gets down to mechanical factors such as strength of wire, method of support to avoid stress points, and ease of handling. There are many claims made for various types of wires but after investigating and testing hundreds of different kinds, we find a straight round wire about .1" diameter to be best.



Baffle Design

Careful attention to the design of baffles on the collecting plates is most important. Small amounts of reentrainment mean tremendous differences in over-all collection efficiencies. It is seen that the "quality" of the collecting surface is far more important than quantity — quantity (sq. ft. of surface or treatment time) in itself is not a criterion of performance.

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"The women screamed and ran out of the machinery room, with the banker hot on their trail," roared Marmaduke Surfaceblow

Marmy's little drip

"BILGEWATER on top brass monkeying around in the power plant," roared Marmaduke Surfaceblow in his foghorn voice at the Bent Propeller Bar yesterday. "I'll tell you guys about a banker who put in his two-cents' worth, but it caused the taxpayers to shell out $50,000 in damages."

There was no reason I could see for this sudden outburst. Still chuckling from Marmy's goat story in the April issue, I had dropped in to see if the unpredictable consultant would cough up another slap-stick yarn.

Nursing my short beer at the crowded bar I was about to give up and go back to the office when Marmy bellowed his sudden blast. The salty looking characters lined up along the bar and seated at the checkerboard tableclothed tables were startled, but only for an instant. Knowing a good thing was about to happen, we all settled down to listen to the story.

The sly old troubleshooter worked up a 26-inch vacuum on his cargo pump, then took a healthy drag from his bottle of Sandpaper Gin. With his tanks ballasted, he turned to his audience and continued:

"Now hear this," he roared so loud that the brightly polished bent propeller on the back bar vibrated like a tuning fork. "Back in 1923 I had a job installing water-works machinery about the country. One of the slickest municipal plants that I had the pleasure to help build was in a small Illinois town on the Mississippi River. The town was perched on top of a hill by the river. The water-works pumping station was down below the hill, just downstream from a long dam which backed up a lake over 65 miles long.

"I liked everything about that station. The lake above the dam formed a vast settling basin for the river silt. The pump suction lines went to the dam, giving it a good suction head. That meant that the pumps started delivering water instantly any time they were started.

"The pumps discharged into a high reservoir on top of the highest point in town. So they pumped against a 190-psi discharge head to fill the reservoir. It was an ideal pumping setup any way you looked at it.

"The pumps were big vertical triple-piston jobs. Their drive shafts were at the top, attached to heavy induction motors through solid gear

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1 SCR	2,000	50	37.8	920
1¼ SCR	2,700	50	51.0	1,370
1½ SCR	4,000	50	75.6	1,840
2 SCR	8,000	25	151.0	3,570
2½ SCR	12,900	15	244.0	4,500
3 SCR	17,000	15	320.0	6,600
4 FLG	27,000	8	510.0	8,900
6 FLG	54,000	5	1020.0	17,800

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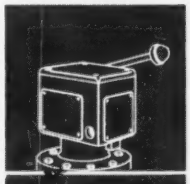
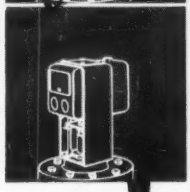
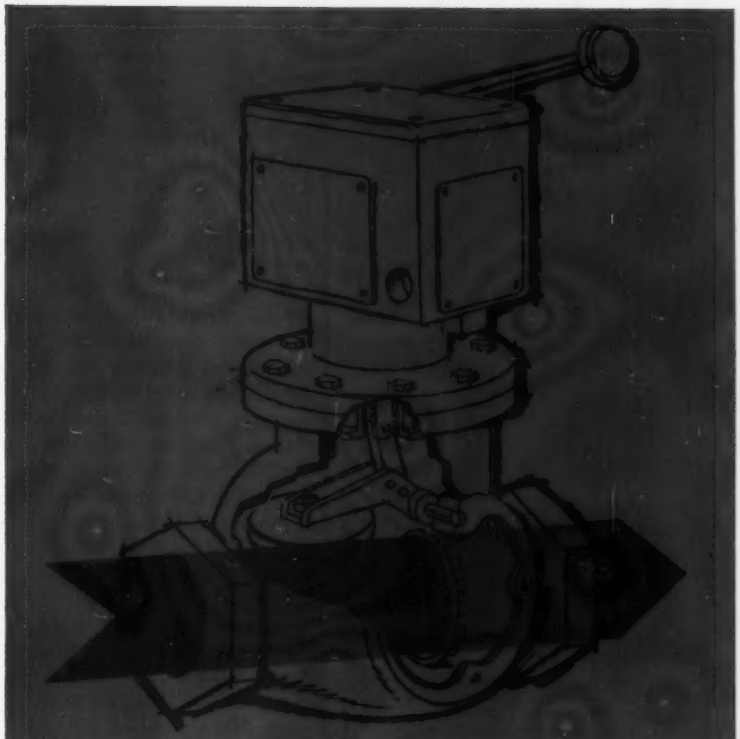


H-117 HYDRAMOTOR, electric reset, with either fixed opening speed or adjustable opening speed regulated to design of equipment.





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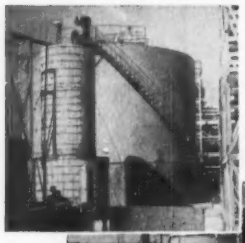

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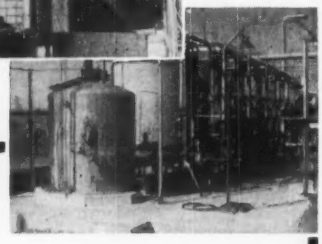

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50 Years of Progress

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CLAYTON 3 — H&T SERVICE — NEW JERSEY

Marmaduke

Continued from page 146

trains. Talk about capacity: the town water consumption usually required only an hour's operation of one of the two pumps once a day.

"When I started installing that machinery, they hired Gordon Hookens, a bright young local mechanic, to help me. He was to be the operating engineer. That job ran so sweetly that Gordon gradually fell into a set routine. He'd pump up the reservoir in the morning. Then after cleaning up the station he'd take the rest of the day off. But he was careful to stay in town just in case they had a fire and needed more water than the reservoir held.

"To start a pump, Gordon would flip the starter switch each morning. Then he'd shut down the motor as soon as the reservoir was full. That usually took about an hour each morning. He always left the suction and discharge valves wide open, which was OK. So the only operating he really did was starting and stopping the motor. Gordon was proud of the station and kept the bright work and paint shining. That guy had a good thing and he knew it.

"I stuck around for a few days after the station was dedicated, just to make sure that Gordon knew his stuff and that all the bugs were out of the plant. Then I shoved off to install a new pump and to bore out the cylinders of an old one in a station up in Wisconsin. But just as I completed that job six weeks later, my boss sent me an SOS from St. Louis. He said one of the pumps was completely wrecked in my dream station on the Mississippi River. He wanted me to drive down there on the double to see what could be done to straighten out the plant.

"I arrived at midnight and dropped anchor at the station before checking in at the hotel. The station was locked, but I flashed my light into the window. What I saw there really hurt. The pump's discharge chamber was a total wreck. It was a large casting at least 1½ inches thick. The pump's shaft looked like it was also badly bent, leaving little to be salvaged. Only thing I could see was installing a complete new unit. The spare pump was OK, so the town wasn't without water.

"When I turned into my bunk at the

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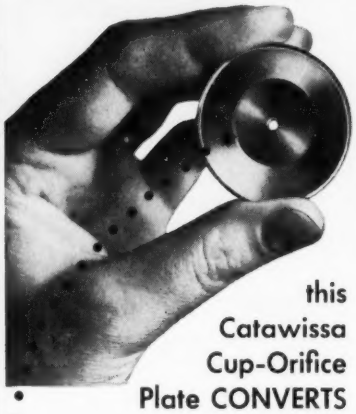
and sure-fire **DEPENDABILITY**

for metering, measuring, controlling any piped material!



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circle 292 on Reader Service card, p 99

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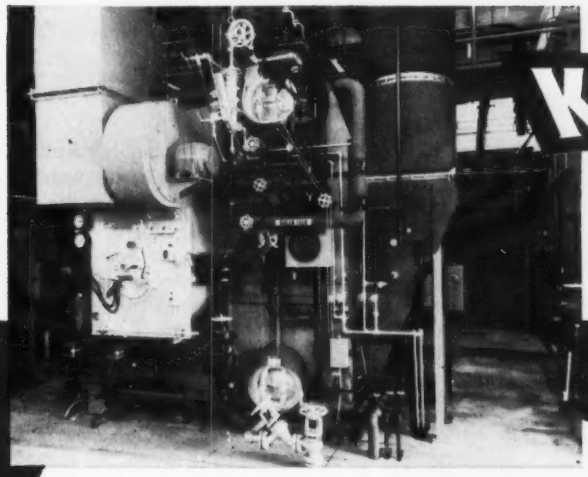


HERE'S THE GRAPHIC PICTURE of how

KEELER

supplied the nation's new steam requirements during 1958 . . .

KEELER STEAM GENERATOR SALES — 1958

(*indicates more than one unit)

ABBOTTS DAIRIES
ADAMS STATE COLLEGE*
AGNEW STATE HOSPITAL*
ALICE MANUFACTURING CO.
AMERICAN CHICLE CO.*
ARMY MAP SERVICE, INC.
ATOMIC ENERGY COMM.*
BARCLAY ELEM. SCHOOL*
BARRETT LEATHER CO.
BREESE, CITY OF
CAMDEN HIGH SCHOOL
CENTRAL LAUNDRIES CO.
CHICAGO TOWEL CO.
CHINA TRADE & IND. SERV.
CHIPPEWA COUNTY HOSP.*
CITIZENS GEN. HOSPITAL
CONCRETE STRUCTURES
CONTINENTAL CAN CO., INC.
ROBT. GAIR PAPER PROD.
COOPER HOSPITAL
DANE CO. HOSP. & HOME*
DEARBORN CIVIC CENTER*
DIXIE CUP CO.
DOLL PAPER CO.
EASTERN HIGH SCHOOL*
EASTERN STATE HOSPITAL
EBENSBURG STATE SCHOOL AND HOSPITAL*
EVANS & CO., JOHN H.*
FLOYD BENNETT FIELD*
FORT LEONARD WOOD*
FORT STEWART*
FRANCE REFRACTORIES CO.
FRENCH CO., R. T.
GALLAUDET COLLEGE
GAYLORD CONTAINER CORP.
GEIGY CHEMICAL CORP.
GENERAL MILK CO.*
GEORGETOWN UNIV. HOSP.
GLEN MILLS SCHOOL
GRANT HOSPITAL*
GRIFFISS AIR FORCE BASE
HAGERSTOWN RUBBER CO.
INTERSTATE CONTAINER CO., READING CRGTD. DIV.
JUNIATA COLLEGE
KANSAS STATE PEN.
KENT COUNTY HOSPITAL*
KEYSTONE RFG. & MFG. CO.
LANCASTER LEAF TOB. CO.
LANKENAU HOSPITAL
LEA & CO., DAVID M.
LINCOLN AIR FORCE BASE
LODI REALTY CORP.
LONGWOOD GARDENS EST.
THE MARTIN COMPANY
MARYLAND RIBBON CO.
Wm. McKINLEY MEM. HOSP.*
MEMORIAL HOSP., Wake Co.*
MERCY COLLEGE
MILLERSVILLE STATE TEACHERS COLLEGE
MONTGOMERY HOSPITAL
MORGAN PAPER CO., INC.
MOSS REALTY CO.
MUSSELMAN CO., C. H.
NEW JERSEY NAT. GAS CO.
NORTHAMPTON CO. HOME
OAKWOOD HOSPITAL
PACIFIC GAS & ELEC. CO.*
PALACE LAUNDRY
PENNCO DISTILLERS, INC.
PIGEON FALLS COOPERATIVE CREAMERIES
POINSETT HOTEL
REEDVILLE OIL & GUANO Co.
RELIABLE KNIT PROC. CO.
M. H. RENKEN DAIRY CO., UNITED CREAMERIES DIV.
ST. CHARLES HOSPITAL
ST. FRANCIS HOSPITAL
ST. FRANCIS VOC. SCHOOL
ST. JOHN'S HOSPITAL
ST. LAWRENCE HOSPITAL
ST. LAWRENCE UNIVERSITY*
ST. MARKS HOSPITAL
ST. MARY'S HOSP. & CONV.*
SCHWEITZER, INC., Peter J.
SCOTT HIGH SCH., Jessup W.*
SMITH-CORONA MARCHANT*
SNOW COLLEGE
SOUTHWEST MO. STATE TEACHERS COLLEGE*
STATE FARM SHOW BLDGS.*
SWIFT & COMPANY
UNION CARBIDE & CHEMICAL CORP.*
UNITED AIRLINES, INC.*
U.S. AIR FORCE, AERO. CHART & INF. CTR.*
U.S. COAST GUARD*
U.S. TERMINAL ISLAND
VASSAR BROTHERS HOSP.
WINTZER CO., G. A.
WISCONSIN STATE COLLEGE
WOODROW WILSON REHABILITATION CTR.
WYOMISSING GLAZED PAPER COMPANY*

Each dot on the map indicates a new Keeler Steam Generator sold for various points throughout the nation during 1958. These installations represent an approximate 3,000,000 lb/hr rated steam capacity added during 1958 to serve the power, process, heat and special steam needs of the distinguished group of purchasers listed.

See for yourself why more and more steam users have come to rely on Keeler over the years! There's a size and type available for your requirements, from low cost package units to 80,000 lb/hr and field erected units up to 200,000 lbs stm/hr capacity—for all fuels and all types of firing!

You'll find Keeler's 95 years' experience in producing thousands of steam generators for domestic and foreign use is your assurance of a reliable, efficient source of low cost steam. *Write for illustrated bulletins, full data . . .*

E. KEELER CO. • 200-300 West St., Williamsport, Penna.

Offices in principal cities — In Canada: Canadian Vickers, Ltd., Montreal, P. Q.

1864/1959
95th ANNIVERSARY

The Seal of Quality in Water Tube Steam Generators

KEELER WATER TUBE Boilers

For more facts circle 294 on Reader Service card, p 99

R-P&C bar stock valves

rugged, compact, economically priced

1. These valves are made from high quality bar stock to withstand high pressure service.

2. Compactly designed, R-P&C Bar Stock Valves are particularly advantageous for close coupled installations in instrument lines or on panel boards.

3. Although designed for control service, the construction of these valves is suitable for general purpose as well.

4. Special techniques, developed by R-P&C for manufacture of Bar Stock Valves, permit these valves to be priced lower than conventional Forged or Cast Steel Valves for similar service.

NOTE: *Valve No. 1070 in ¾" and 1" sizes has renewable seats and discs*

R-P&C Bar Stock Valves are especially recommended for meter, gauge, sampling, or test valves on equipment requiring a reliable, compact valve to withstand high pressure service.

In addition to bar stock valves, our R-P&C distributors offer you a complete line of R-P&C gate, globe and angle valves in all standard materials: bronze, electric furnace iron, cast steel, forged steel... plus specialties for many uses.

See him—or write

R-P&C VALVES

ACCO

R-P&C Valve Division, American Chain & Cable Company, Inc.

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

Marmaduke

Continued from page 148

hotel that night I couldn't figure out why that pump had been wrecked—not with Gordon running the show. Next morning I drove over to the pumping station as soon as I had breakfast. I wanted the story straight from the operator.

"He told me the town had elected new officers two weeks before. The old crowd was thrown out, so a new gang took over Town Hall. The local banker became the new mayor. He got elected by promising to spend less money and to cut down on town expenses. And his idea of efficiency was to lend everyone a hand by breathing down their necks.

"One morning Gordon found the banker showing a half dozen females through the pumping station. They must have been there some time because Gordon was busy inspecting the suction line at the dam.

"Returning to the plant, he stepped into the machine room to start the pump for its usual one-hour stint. But he ran into the wide-eyed ladies clustered around the mayor, who was busy explaining the pump's operation. Before going to his visitors, Gordon leisurely walked over to the switch and flipped it closed. That did it. Instead of the familiar hum of the big motor and the steady pulsations of the reciprocating pump, there was a grinding noise. Then the pump suddenly burst with a loud metallic tearing sound. Pieces of cast iron and water splattered in every direction. Good thing the visitors were at the motor end of the pump.

"The women screamed and ran from the building, trying to cover their faces and heads with their arms and hands. The mayor lost his dignity and hotfooted after them. Gordon quickly opened the pump's switch—but the damage was done. Soon as the grinding noise stopped the mayor came timidly back inside. He was white as chalk.

"'What in good heavens have you done?' demanded the mayor, pointing to the pump while trying to appear dignified and indignant at the same time.

"'I don't know,' admitted Gordon, scratching his head. 'I've been starting this pump exactly like this every morning for weeks. Can't figure any

For more facts circle 295 on Reader Service card, p 99

For more facts circle 296 on Reader Service card, p 99

Decision made 21 years ago proved to be the right one

Garnett, Kansas Light Plant in 1938, selected Standard Oil diesel lubricant

Situation: In 1938, when Garnett, Kansas put two diesel engines (one 600 hp and one 1000 hp) into service, plant management selected a Standard Oil diesel lubricant. In 1948, when a 1400 hp engine was added, the performance from the Standard lubricant caused management to make the same choice. In 1955, when a 2100 hp duel fuel unit was placed in service, STANODIESEL Oil M was chosen.

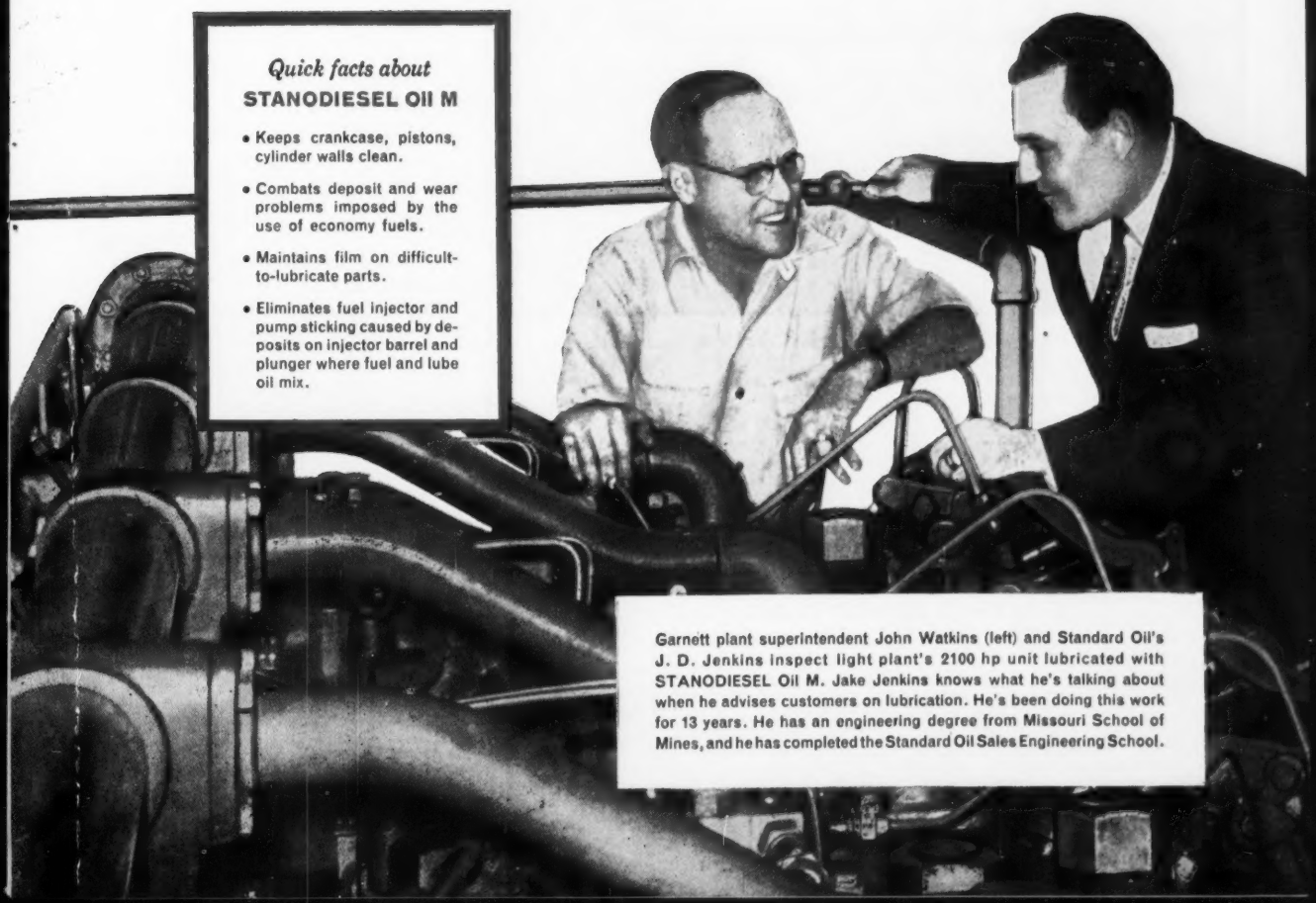
What has happened: At the Garnett plant, stuck rings and dirty pistons are unknown. The 1400 hp unit was in service nine years before reringing. Overhauls are made only every five years. The top performance from STANODIESEL Oil M and the technical service provided by lubrication specialist, J. D. Jenkins, have made possible first rate, uninterrupted, low cost electric service.

What you can do: The Standard Oil salesman near you in any of the 15 Midwest or Rocky Mountain states has the full story about STANODIESEL Oil M, and how it will perform for you. Call him. Or write, **Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by the use of economy fuels.
- Maintains film on difficult-to-lubricate parts.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.



Garnett plant superintendent John Watkins (left) and Standard Oil's J. D. Jenkins inspect light plant's 2100 hp unit lubricated with STANODIESEL Oil M. Jake Jenkins knows what he's talking about when he advises customers on lubrication. He's been doing this work for 13 years. He has an engineering degree from Missouri School of Mines, and he has completed the Standard Oil Sales Engineering School.

geared TODAY for TOMORROW

with VIKING "gear-within-a-gear" PUMPS

Viking "gear-within-a-gear" pumps are adapted to the handling of fluids ranging from gaseous liquids, such as LP-Gas, to semi-solids such as tar, hog fat, soap stock and cookie dough.

This positive displacement pump has the unique and original Viking "gear-within-a-gear" design. A 48-year engineering background has developed it to the place where industry often depends on its pumping where others fail.

A size range from ⅔ to 1050 gallons per minute answers endless pumping problems.

Custom construction to fit the need is an every-day experience.

Types of metals include cast iron, a full range of bronzes, as well as stainless steel, nickel, monel, nodular iron, steel, ni-resist and other special metals.

Send today for catalog Series 59SW

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps

See Our Catalog in Sweet's Industrial Construction and Plant Engineer's File

For more facts circle 297 on Reader Service card, p 99

MOST MAJOR U.S. POWER PRODUCERS REDUCE COSTS with PANALARM ANNUNCIATORS

MAXIMUM INFORMATION on all process variables . . . the result of 10 years system engineering by Panalarm and major power producers. That's why Universal Series 50 is the power industry's most informative annunciator. Trouble anywhere is signalled instantly—*before* it can grow big and expensive. "Off-normals" are pinpointed instantly, accurately for fast remedial action, reducing costly "outage" losses.

Economical, highly flexible design facilitates system expansion. Can be simply adapted to your exact requirement, avoiding costly custom designing. Proven components—e. g., almost 1,000,000 dependable Panalarm developed relays have been used in Panalarm Annunciators.

Ask your nearby Panalarm sales engineer to show you why Universal Series 50 is the power industry's No. 1 annunciator choice . . . how its adaptability and reliability can help increase your profits . . . by producing maximum information and reducing costly "outages." No obligation, of course.

Write for Catalog 100 B today.

PANALARM®

Division of

PANELLIT, INC.

7401 No. Hamlin Ave., Skokie, Ill.

Marmaduke

Continued from page 150

reason why she should have busted.' Then he added skeptically, 'Did you happen to touch anything while I was out of the building, Mr Hissey?'

"'Why yes,' admitted the mayor, taken off guard. 'I saw water leaking from the gland of that big valve over there, so I closed the valve. Then I took a wrench from the rack and tightened the gland nuts until the leak stopped. I hate to see water leaking out of machinery—costs money, you know.'

"'Holy cow, that's the discharge valve you closed,' yelled Gordon. 'Hell, only two things could happen with that valve closed when I started the motor. Either the motor would stall or the pump's discharge end would burst. And burst she did. As for that gland leaking, I close and then open that valve once a week to make sure the valve doesn't freeze. I did that when I walked into the station this morning. That's why the gland was leaking; because the stem disturbed the packing. I was going to tighten those nuts as soon as I got through pumping up the reservoir this morning.'

"The mayor was speechless. He opened his mouth to say something, but nothing came out. He then hung his head and quietly walked out of the building to join the excited ladies.

"So the mayor had stopped a tiny leak, but wrecked machinery that finally cost the taxpayers $50,000 to repair. And all that expense because he stuck his oar into the operating engineer's puddle."

Marmaduke stopped talking. Then he doubled his huge right fist and gave the bar one tremendous blow. "If you don't trust your operating engineer," he roared, "fire him. If you do hold him responsible for your machinery, then leave him the hell alone."—SME

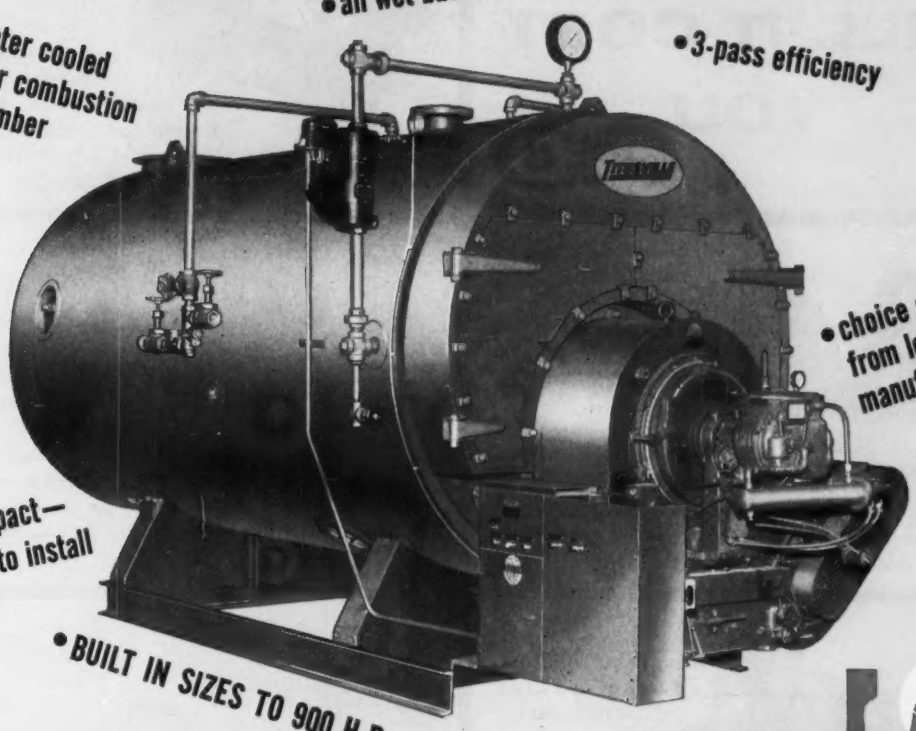
SENDS REGARDS

Please give my best regards to Mr Surfaceblow next time you drop into the Bent Propeller Bar. I sure enjoy his stories although I must say that he was pretty hard on the machinery in his August yarn.

N M NIELSEN, *Porto Alegre, Brazil*

For more facts circle 298 on Reader Service card, p 99

MOST MODERN unit of its type in the industry today!


• all wet back construction
• water cooled rear combustion chamber
• 3-pass efficiency
• choice of burners from leading manufacturers
• compact— easy to install
• BUILT IN SIZES TO 900 H.P.

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3-PASS UNIT

FOR POWER AND HEAT

Just off the press—fully descriptive folder plus specification and rating sheets. Send for your copy.

This is the Titusville 3-Pass Unit that is acclaimed everywhere for truly outstanding performance and economy in steam production. Efficiencies greater than 80% are achieved in normal operation, with maintenance costs at new lows even for Titusville. Get the TITAN facts now—and compare! Write us.

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THE TITUSVILLE IRON WORKS CO.

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BOILER DIVISION: BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units. **PROCESSING EQUIPMENT DIVISION:** Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters. **FORGE DIVISION:** Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

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Plants at Titusville, Pa. and Warren, Pa.
Offices in Principal Cities

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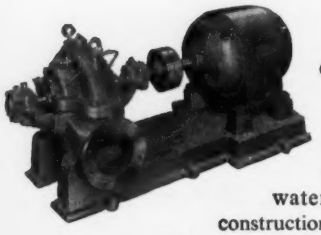
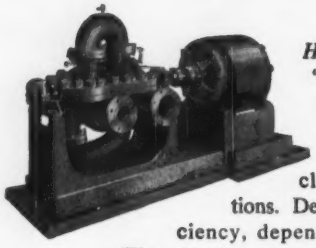
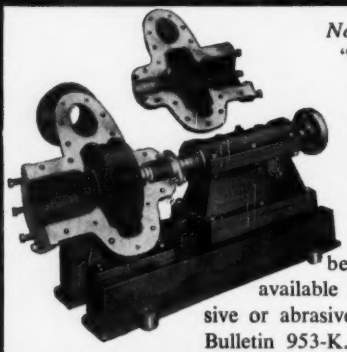
HOW MUCH WILL IT COST YOU



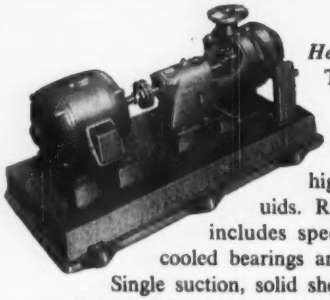
Clear Water Pumps: "Buffalo" Double Suction Pumps assure maximum efficiency in clear water service. Rugged construction provides long life with minimum maintenance. 10 to 14,000 gpm capacities. Write for Bulletin 955-R.



High Pressure Pumps: "Buffalo" Multi-Stage Pumps are ideal for boiler feed and other clear water applications. Designed for top efficiency, dependability, long life. These husky pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Write today for Bulletin 980-D.



Non-Clogging Pumps: "Buffalo" Diagonally Split-Shell Pumps are specially designed for moving high consistency liquids. Down-time, wear and wedging are reduced. Rubber-lined models are available for pumping corrosive or abrasive liquids. Write for Bulletin 953-K.



Heat Transfer Pumps: These special "Buffalo" pumps are engineered for handling high-temperature liquids. Rugged construction includes special alloys, water-cooled bearings and special packing. Single suction, solid shell design is highly efficient. Write for full details.

Chemical Liquid Pumps: These special "Buffalo" Pumps are engineered for severe service in handling most corrosive, abrasive or high consistency liquids. Ten special types are available in a variety of trim. Write for Bulletin 982-A.

NOT TO INSTALL "BUFFALO" PUMPS?

How "Buffalo" Pumps Can Save You Money Right Away: "Buffalo" offers a broad line of pumps. This means you can usually choose the right pump to fill almost every liquid-moving need. With "Buffalo" Pumps you pay only for the type, size and capacity required — no more. This often means substantially lower initial cost.

How "Buffalo" Pumps Can Save You Money Over the Years: "Buffalo" Pumps are engineered for peak hydraulic efficiency. This gives you consistently lower pumping costs. "Buffalo" Pumps are ruggedly built throughout. Extra heavy-duty components reduce maintenance costs over a longer productive life span. "Buffalo" Pumps are designed for quick, easy access to inner parts. Thus routine maintenance costs are lower. "Buffalo" Pumps feature parts interchangeability. This means further savings in reduced parts inventories.

Your nearby "Buffalo" Engineering Representative will be glad to help you choose the pumps that will most economically fill your needs. Phone him today, or write us direct.

"Buffalo" PUMPS

BUFFALO PUMPS
Division of Buffalo Forge Co.
488 Broadway Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

New Electric Generating Station for Memphis Equipped with Phelps Dodge Condenser Tubes!

The new Thos. H. Allen Electric Generating Station of the Memphis Light, Gas & Water Division, City of Memphis, Tenn., is designed to answer the need for increased electric power in Memphis and surrounding Shelby County. This mammoth plant, designed by Burns and Roe, Inc., and constructed under their supervision, has three hydrogen-cooled turbine generators and three multiple-pass condensers, with a new capability of 812,500 kilowatts.

Within the condensers are more than 298 miles of Phelps Dodge Admiralty condenser tubes, weighing about a million pounds. These 30-foot-long tubes help each unit condense steam from the generators at the rate of over one million pounds per hour. Each condenser has a heat transfer-rate of 980 BTU per pound of condensed steam.

Phelps Dodge condenser tubes are known for lasting quality and expert workmanship in industries using heat transfer equipment. This reputation has made Phelps Dodge a leading manufacturer of copper and copper-alloy tubes for the fabricators of condensers and heat exchangers.

PHELPS DODGE COPPER PRODUCTS

CORPORATION

300 Park Avenue, New York 22, N. Y.

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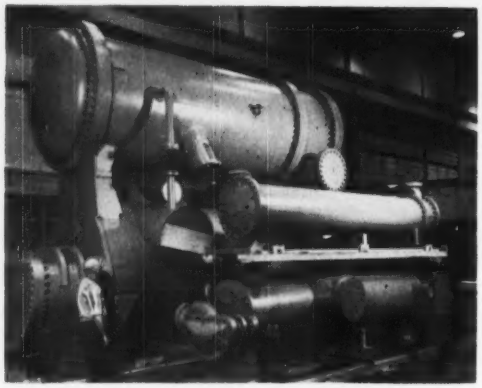
Powerscope . . . A selective look at

Adding "beef" to the power picture



Water-chilling vessels for world's largest refrigeration machine dwarf average-size set on shipping dock of their manufacturer, Carrier Corp, Syracuse, N. Y. Giant assembly is one of two identical units destined for use in air conditioning the 60-story Chase Manhattan Building in New York City. When the record-breaking shells—each 6 ft in diameter—are connected to a centrifugal compressor, the machines will each provide cooling equal to 3550 tons of melted ice. Nearly 18,000 gallons of water per minute will pass through the cooler and condenser shells of each unit. The big coolers will work alongside a smaller chiller on the 11th and 31st floors. Total capacity of the four machines: 9140 tons, one of the largest systems for a single office building.

World's largest power plant operating on gas gained from the subsoil burning of coal is planned for the Uzbek region of the Soviet Union, according to an announcement by Tass. Some 2300 million cubic meters of gas will ultimately be available for the 100,-000-kw gas turbine now under construction in Leningrad's heavy machine plant.

McGraw-Hill World News reports largest slag-tap boiler in Europe was recently installed in West Germany. Designed and built by Maschinenfabrik Augsburg-Nurnberg Ag, it has a continuous maximum output of 900,000 lb per hr, design pressure of over 3000 psi and a superheated steam temperature of about 986 F.

Keeping pace with demand for larger and more powerful transformers, Pennsylvania Transformer Division, McGraw-Edison Company has shipped the highest-capacity transformer the company has ever made: a 315,000-kva unit custom-designed for Wisconsin Power Company. The transformer will step up a generated voltage of 17,200 volts to 230,000 volts for transmission over the utility's lines. When filled with oil (nearly 15,000 gallons are used for cooling and insulating) the transformer weighs 521,000 lb.

Thermal power plant under construction in Russia is among world's largest, reports McGraw-Hill World News. The plant will have an ultimate capacity of 1,200,000 kw; its annual ultimate output is estimated at 18,000,000,000 kwhr—or about half of the electric power output in Italy today. First turbine set—150,000-kw capacity—is slated for operation during 1960.

Winding of the 97-ton rotor is nearly complete at the Westinghouse Electric Corporation for the 330-mva 45-psig 16.5-kv turbine-generator for the Consolidated Edison Company of New York. This 1800-rpm innercooled generator is the largest unit of this speed ever built. Steam conditions are 355 psig, 1000 F, 1.0-in. Hg abs. At maximum load, the turbine will pass 2,200,000 lb steam per hr. Because of large volumetric flow to the turbine exhaust, double-flow 44-in.-long low-pressure blades are used. The turbine-generator will be installed at Con Ed's Indian Point nuclear plant now under construction near Buchanan, N. Y.

Power equipment "on the cuff"

Makers of power equipment can now set up full programs for installment sales of their income-producing equipment, obtain complete financing and have the financing company handle all the customer credit, collection and paperwork at no extra charge. This is the basis of a plan released by Standard Financial Corp, New York, N. Y.

The power industry runs the risk of paying unnecessarily high prices for its capital equipment due to its practice of booking orders in bunches. This warning came from William F Crawford, president, Edward Valves, Inc. In a talk before the second annual ISA Power Industry Symposium in Kansas City, he added that cyclic buying, taxation and current labor climate are shifting the burden of pioneering research and development in the power industry from the manufacturer to the ultimate owner. Because of this shift, Mr Crawford cautions that ever-greater cooperation between manufacturers and suppliers will be necessary.

this month's power-field happenings

ART SOMMER, Assistant Editor

Metric system for the U.S.?

Speaking before the American Physical Society, Secretary of Commerce Lewis L Strauss said that he is convinced that ultimately the U.S. must shift to the metric system. He pointed out many advanages for the shift other than ease of calculation and conversion. There is, he said, no doubt that the conditions of our times—the increasing importance of science for all phases of life as well as the increasing inter-dependence of nations through security, travel, communications, exchange and trade—all require a convergence on one system of measurement.

Meeting the engineering shortage

Westinghouse Educational Foundation will donate grants and equipment valued at $1,625,500 to American universities and individual scholars during 1959—the largest amount ever budgeted by the organization for a single year.

A new experiment in cooperative education —combining graduate studies and research in engineering and the physical sciences— will be initiated this fall at U of Cincinnati. Program is considered a practical workable way of helping industry meet its urgent needs for more men with advanced education in the basic sciences.

"Serious attention" to the establishment of "one common four-year undergraduate curriculum in engineering," was called for by J C Michalowicz, head of the electrical engineering dept of the Catholic University of America. In a paper presented at the Middle Eastern District Meeting of AIEE, he points out that establishment of a common program would encourage pooling of engineering talents and facilities on our campuses; and "would lead to a great unifying force in engineering education, if not to developing a more favorable climate for eventually achieving unity within the entire engineering profession."

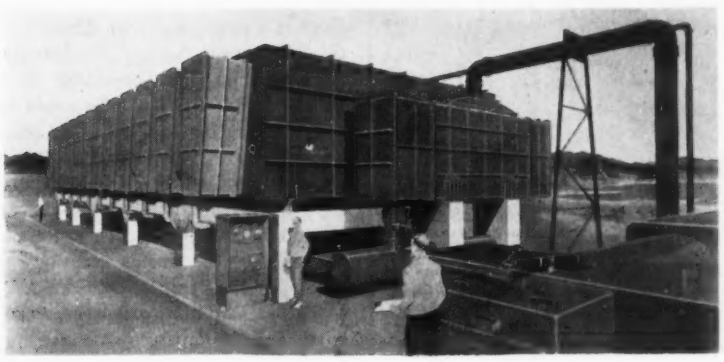
A warning that "engineers must strive to be less immersed in their own profession" was sounded by H C Pyle, president, Monterey Oil Co, at the 85th annual commencement of the Colorado School of Mines. Pyle told graduates to be more universal in interests, to rely on self-discipline in finding interests outside engineering and to be influential forces in resolving political and economic problems throughout the world.

Curing a billion-dollar headache

Currently, corporate expenditures for air pollution control are about $300 million annually and may well hit $1 billion a year in the next decade. Development of smaller, more efficient gas-cleaning equipment is an important step forward in meeting industry's needs in air pollution control.

These and other findings stemmed from a day-long Seminar at the Engineer's Club in New York City. Sponsored by Research-Cottrell, Inc, Bound Brook, N. J., the Seminar presented nationally known speakers and released Research-Cottrell's latest lab findings and field experience.

What will a million-gallon-a-day sea-water distilling plant look like?



Designers at Cleaver-Brooks Special Products, Waukesha, Wis., have come up with this concept utilizing the flash-evaporation principle. Studies by the firm of large municipal plants using extraction steam from a turbine-generating station as a heat source and including all costs reveal that sea water can be converted to fresh water for less than one-tenth of a cent per gallon. New developments now on the drawing boards at Cleaver-Brooks indicate further reductions of 15 to 20% are possible.

FLUIDICS

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the know-how
the equipment
and the experience
for solving problems involving fluids

FLUIDICS AT WORK

Selecting water treatment systems to meet your specific needs

Many factors are involved in proper selection of water treatment equipment for specific use. Analysis of the raw water, volume and quality of water required, cost of equipment (both initial and operating), amortization rates and plans for future expansion, to cite just a few. The systems illustrated typify answers to widely varying requirements.

If you are concerned with any phase of water conditioning, bring an outline of your requirements to Permutit. As the largest and most experienced producer of water treatment equipment of every type, Permutit can assure you sound recommendations and the most efficient and economical system available for your particular need.

Write to the Permutit Division, Dept. PO-79, 50 West 44th Street, New York 36, New York . . . or Permutit Company of Canada Ltd., 207 Queen's Quay West, Toronto 1, Ontario; or 207 West Hastings Street, Vancouver 3, B. C.

FLUIDICS covers:

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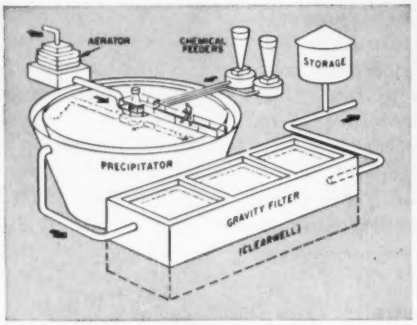
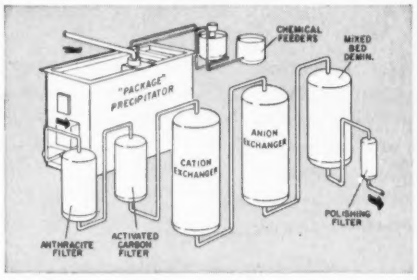
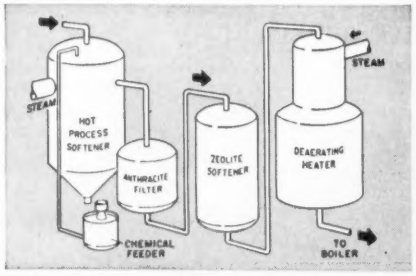


Well water for municipal supply. Aerator reduces CO_2 to reduce acidity, reduces taste and odor and oxidizes dissolved iron and manganese. Precipitator removes turbidity, color, hardness and oxidized iron and manganese. Gravity filters remove remaining traces of turbidity.

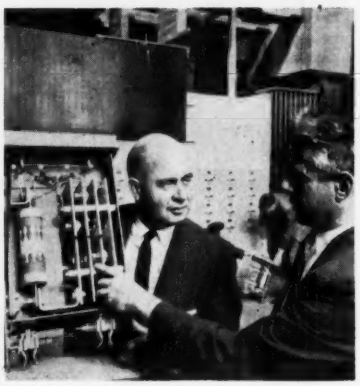


Process water for electronic components. Package Precipitator removes bulk of turbidity, hardness and iron. Anthracite filter removes remaining suspended matter. Activated carbon filter takes out color and absorbs dissolved organics. Demineralizer—cation, anion, and mixed bed—reduces dissolved solids to guaranteed maximum. Polishing filter removes traces of suspended matter.



Water for steam boiler. Hot process softener reduces hardness to a few grains per gallon. Also reduces silica. Anthracite filter removes remaining turbidity. Zeolite softener may be added to system where zero hardness is needed. Finally, the deaerating heater removes oxygen to prevent corrosion.

Reports from the field



Largest silicon power rectifier starts up

First three units of what will be the nation's largest silicon power rectifier installation have been energized at the Hooker Chemical Corporation's Niagara Falls, N. Y. plant. Equipment is used to convert 60-cycle current to direct current for operation of electrolytic cells to produce chlorine, caustic soda and hydrogen.

Each of the four 96-tray units, built by General Electric Company, provides 12,000 amp at 360-v dc. With closed-cycle cooling, unit is rated for a continuous electrolytic load and operates from an input voltage of 13.8 kw, 60 cycles.

Silicon rectifier trays, above, are the heart of each installation. Rectifier sections are enclosed to prevent corrosion. Cooling air for these sections will be circulated through an air-to-water heat exchanger; transformers and regulators are self-cooled.

Instrument Society meeting deals with world progress

Scientists from abroad will play a larger role than ever in this year's Annual Conference and Exhibit of the Instrument Society of America. According to ISA president H C Frost, presentations will be made by experts from Great Britain and other European countries as well as Japan. Delegates to the International Federation of Automatic Control's general assembly in Evanston, Ill. will probably include the nearby instrumentation conference in their schedules.

Major program discussions will cover use of computers in running

For more facts circle 302 on Reader Service card, p 99 For more facts circle 303 on Reader Service card, p 99 ➤

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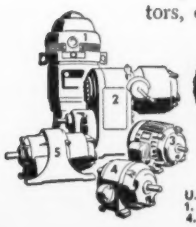

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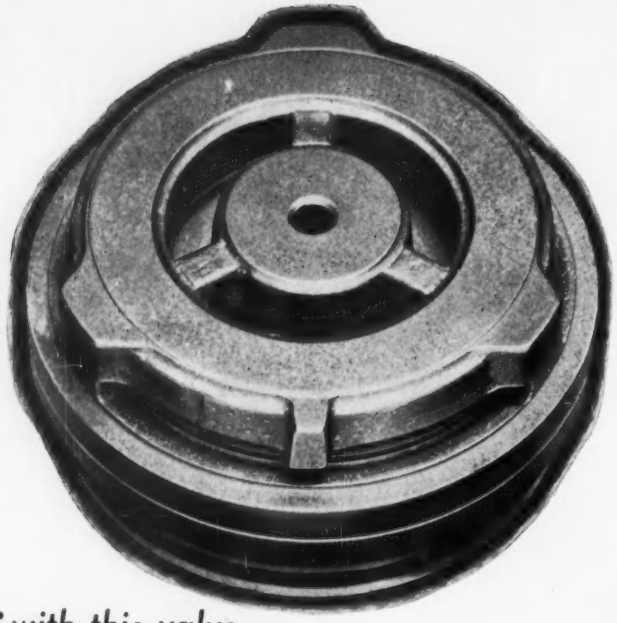
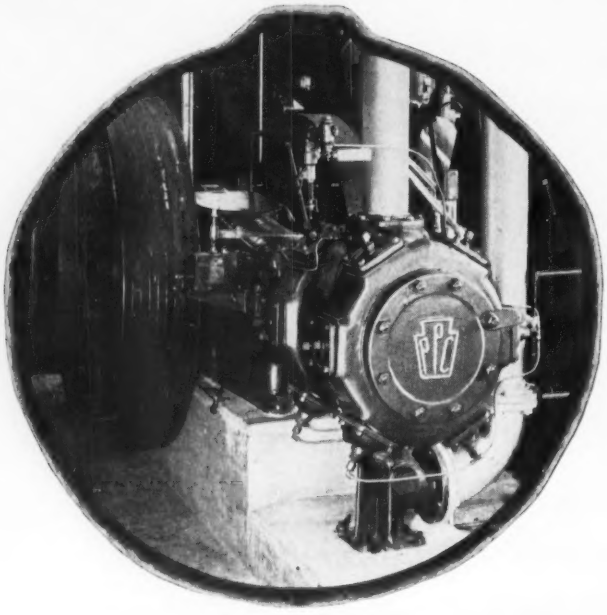


*with this valve

COMPRESSOR RUNS DAY AND NIGHT FOR 20 YEARS



Unusual? Yes, when you are not *getting* performance like this. No, when you have a Pennsylvania Compressor on the job. Long, long service without downtime is standard operating procedure with every Pennsylvania Compressor.

*Reason: the Pennsylvania Air Cushion Valve, constructed without nuts, bolts or screws. Stainless steel valve discs lift against a soft cushion of air; there is no flexing or bending action to weaken them. They will remain perfectly seated over long periods of service.

The compressor above delivered over 20 years of continuous performance . . . three days were lost once when it was moved, but that's all. Isn't it time you were on the receiving end of this kind of sure, sustained performance? Write today for your free copy of "Compressors for Industry" which describes Pennsylvania Compressors from 10 to 350 hp.

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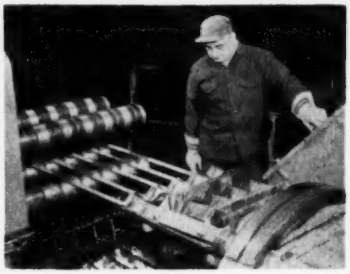
Reports from the field

Begins on page 158

industrial processes, photo instrumentation, action to alleviate shortage of instrument men.

Overall objective, says Frost, is to give industry at large a chance to see what's new in instrumentation. Both management and technical staffs can put their heads together at the 6-day conference, starting September 20th in Chicago.



New tube mill drawbench handles five tubes at once

One of industry's longest multiple-position drawbenches can draw five 200-ft units of copper tube in straight lengths. Drawbench is a feature of the recently opened Scoville Tube Mills in New Milford, Conn.

The tube operation is a separate division of Scoville Manufacturing Company. The new mill adds production of copper tube and pipe to company's already established lines of heat-exchanger and general commercial tube. It incorporates engineering and processing features said to be unique in the industry. "Unitized" mill layout streamlines tube processing—conveyor handling reduces as much time-consuming overhead crane work as possible.

Waste treatment for the plant has a difficult problem to solve: Housatonic river water is used for processing, and copper and zinc content is reduced to less than five ppm before discharge. Up to 400 gpm are handled by the waste-treatment facilities.

Mineral-wool block is versatile for boiler insulation

Low thermal conductivity and wide service temperature range make mineral-wool block an efficient thermal

For more facts circle 304 on Reader Service card, p 99

circle 305 on Reader Service card, p 99 ➤

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*Made of DuPont Teflon. Not recommended for use with alkali metals, fluorine, or fluorine forming compounds

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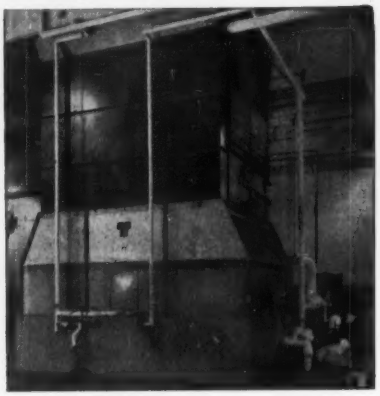

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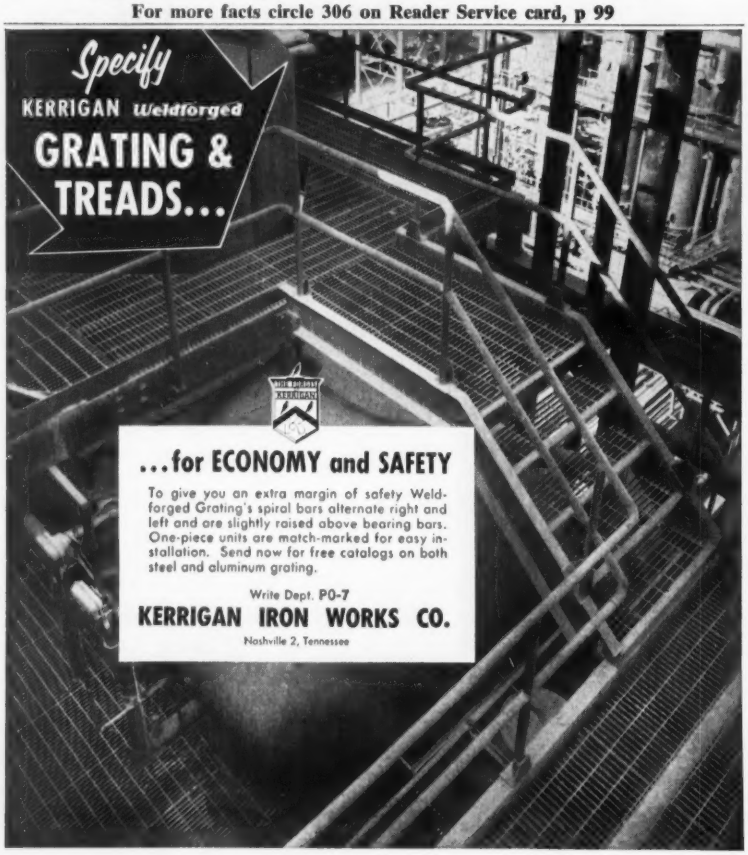
For more facts circle 306 on Reader Service card, p 99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Reports from the field

Begins on page 158

insulator. Structural characteristics and workability mean the material is adaptable to a wide variety of application techniques.

At Philadelphia Electric Company's Schuylkill Station, *Mono-Block*, a felted mineral-wool block with a colloidal clay binder, was basic thermal insulation for new boiler, accessory housings and ductwork. Waterwall tubes of boiler had 18-in. lengths of insulating block laid horizontally between adjacent vertical stiffener bars and against skin casing. First layer was 2-in. thick, so outer surface was flush with edges of stiffener bars, forming a smooth surface for application of second layer. All joints and voids were pointed with white mineral-wool insulating-finishing cement.

Calendar of Events

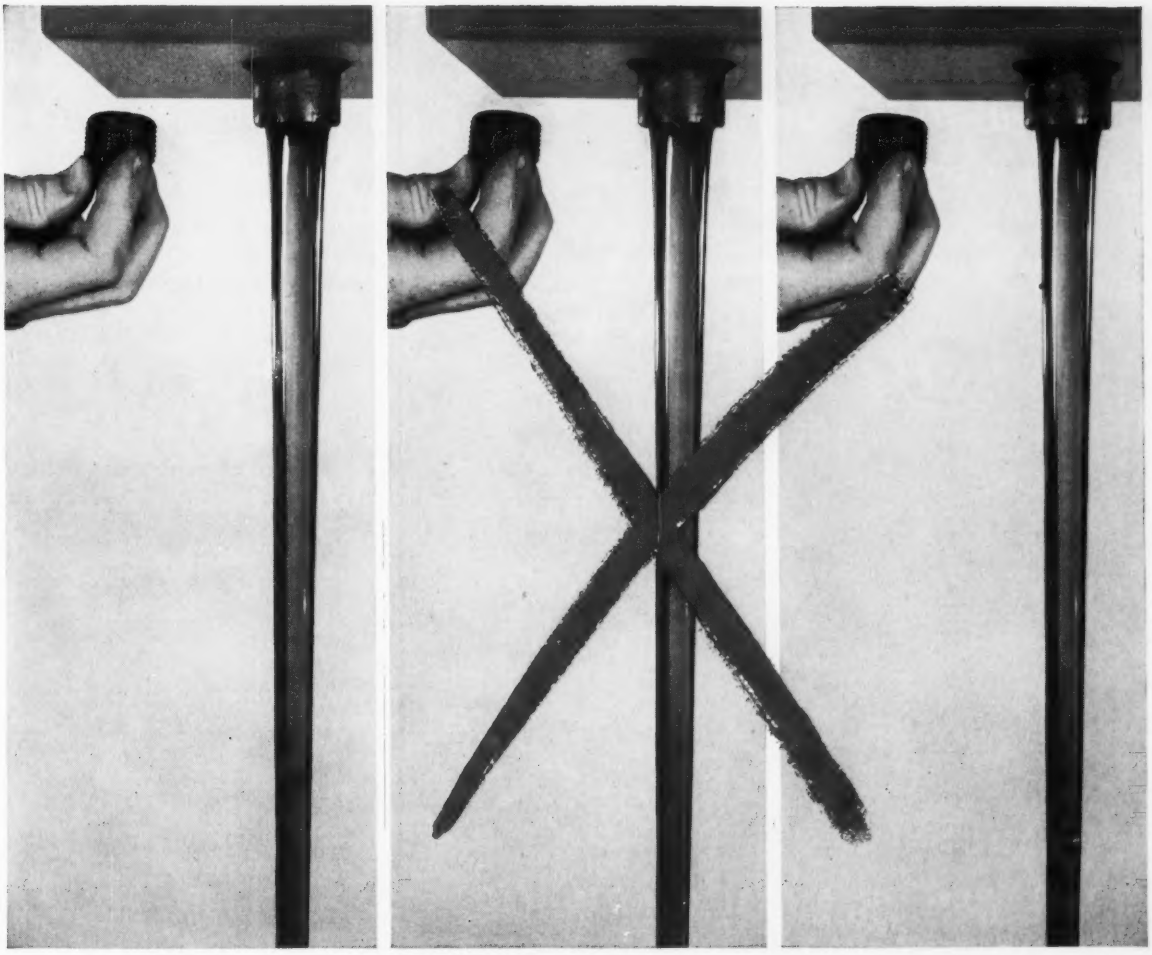
July 26-August 7—Columbia University, Dept of Industrial and Management Engineering, Eighth Utility Management Workshop. Arden House, Harriman, New York. Details from Mrs Rae Wygant, 409 Engineering Bldg, Columbia U, N. Y.

Aug 9-12—American Society of Mechanical Engineers and **American Institute of Consulting Engineers,** Heat-transfer Conference. University of Connecticut, Storrs, Conn. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

August 27—Illinois State Chamber of Commerce, Water Resources Committee: Water Supply Conference. Abraham Lincoln and St. Nicholas Hotels, Springfield. Details: Illinois State Chamber of Commerce, 20 N Wacker Drive, Chicago 6, Ill.

Sept 17-18—American Society of Mechanical Engineers, Engineering Management Conference. Statler-Hilton Hotel, Los Angeles, Calif. Details from ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

Sept 21-25—Instrument Society of America, 14th Annual Instrument-Automation Conference and Exhibit. International Ampitheater, Chi-



HOW TO CUT DRAIN PERIODS,
yet improve hydraulic performance!

Drain periods for a hydraulic system may be extended many times over by switching from straight mineral oils to a premium oil.

This has been proved time and again when the switch has been made to Texaco Regal Oil R&O without altering any other operating conditions.

It's obvious that draining hydraulic systems, cleaning, and replacing with new oil is costly. If one or more drainings can be eliminated the additional oil cost would be warranted.

Straight mineral oil may be satisfactory for some systems, but tests show that Regal Oil R&O can extend the interval between draining at considerable savings. This premium oil is formulated to resist oxidation, rust, foam, and wear.

And there's a bonus! When you do drain, you'll find the system in cleaner condition. Save again on make-ready.

The advantages of switching to Regal Oil R&O are so convincing that Texaco has made a film about it. We'll be happy to arrange a showing at your plant without obligation. Call the nearest of the more than 2,300 Texaco Distributing Plants, or write to:

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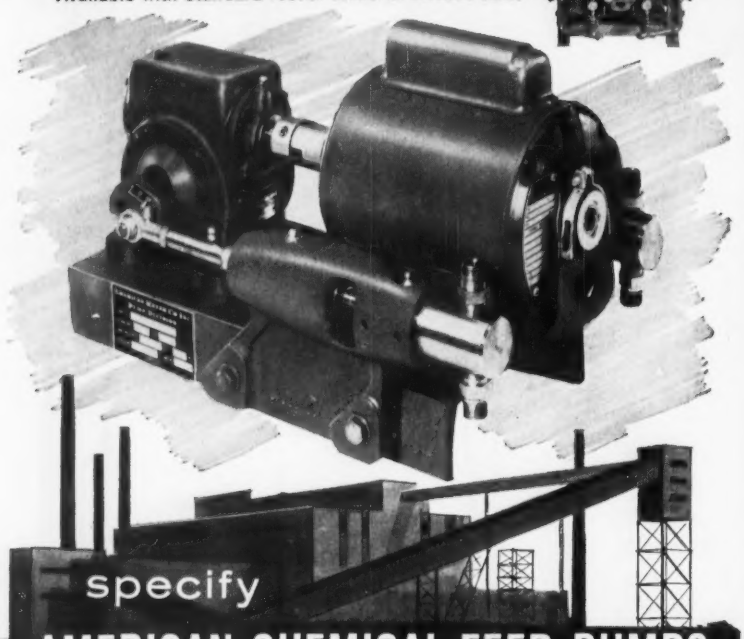

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Want *low initial cost, design simplicity, accurate control* and *minimum maintenance cost?* Get them all with American Series 100 controlled capacity pumps!

Series 100 pumps move specific volumes of fluid with a repetitive metering accuracy of ± 1%, when operating between the limits of 10% to 100% of stroke length. A screw adjustment on the crank provides easy, accurate stroke regulation for capacities ranging from .65 gph to 13.10 gph at a maximum pressure of 1000 psi on Series 100 Simple model. Duplex models have double that capacity.

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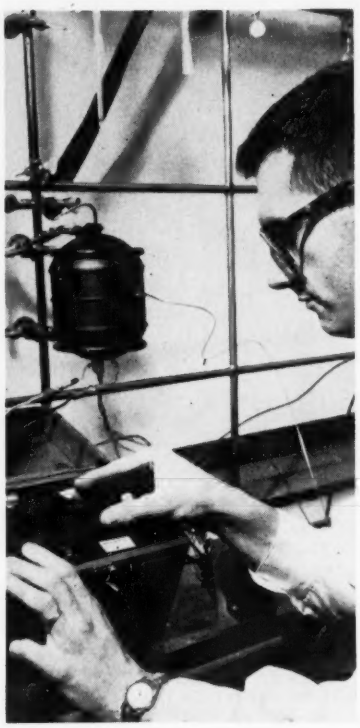
Reports from the field

Begins on page 158

cago, Ill. Details from H S Kindler, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

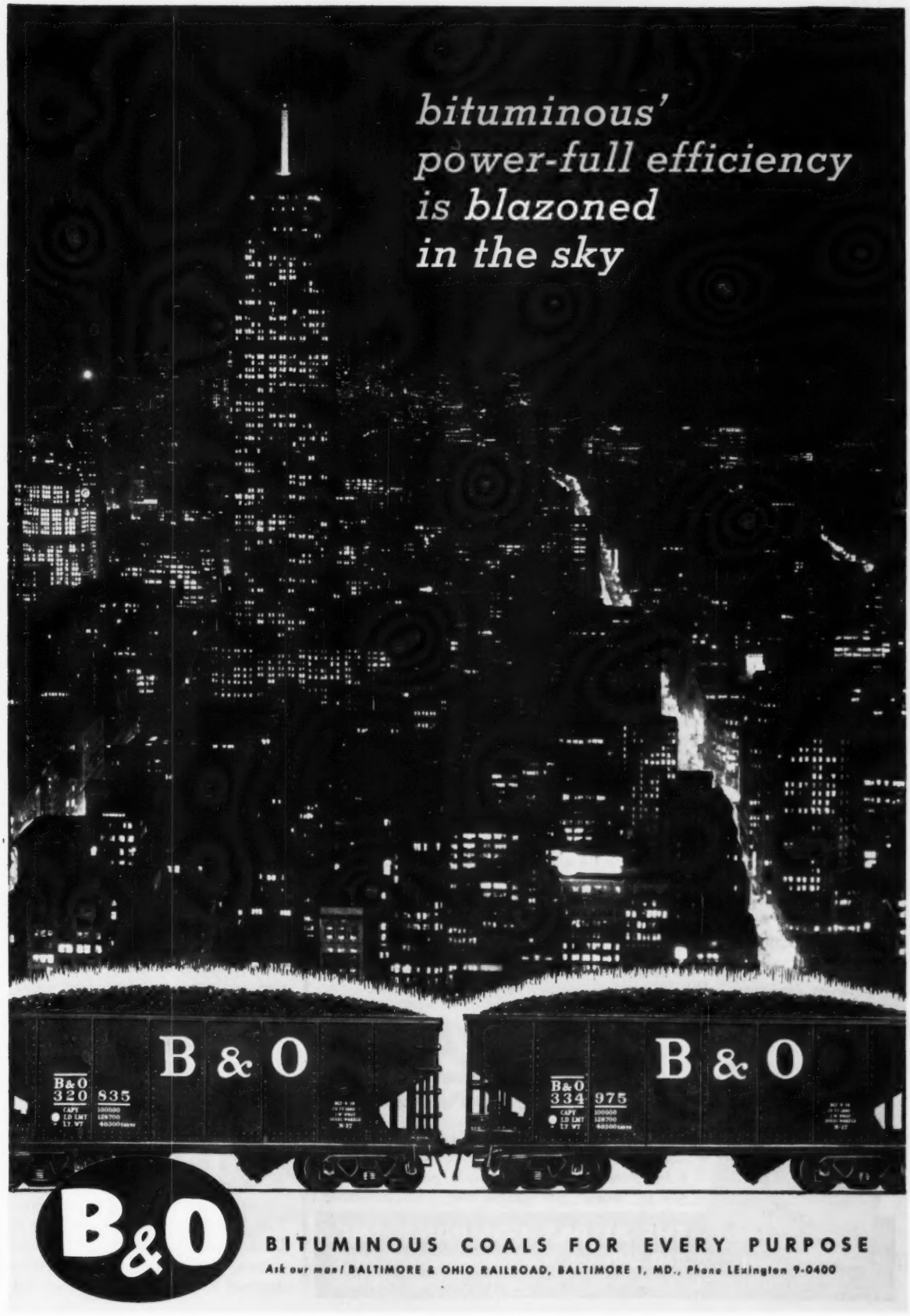
Sept 28-Oct 1—American Society of Mechanical Engineers and **American Institute of Electrical Engineers,** 1959 National Power Conference. Muehlebach Hotel, Kansas City, Mo. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.



Winning atomic generator is a 5-lb midget

Winner of this year's Miniaturization Award, a Martin Company Nuclear Division prototype atomic generator delivers five watts at 8 to 10% efficiency with a 3000 charge of Po_{210}. The Miniaturization Award was established in 1957 by Miniature Precision Bearings, Inc to recognize advances in the art and science of miniaturization.

Called "a significant step toward harnessing nuclear power for peaceful purposes," SNAP-111 is the first device to combine a radioisotopic



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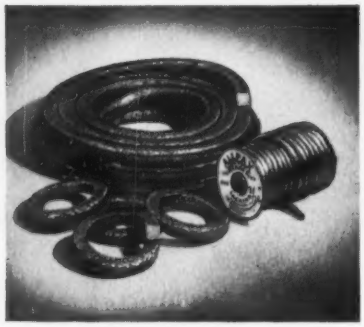

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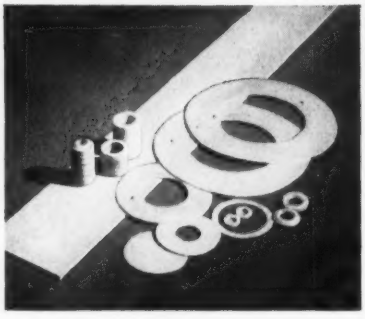

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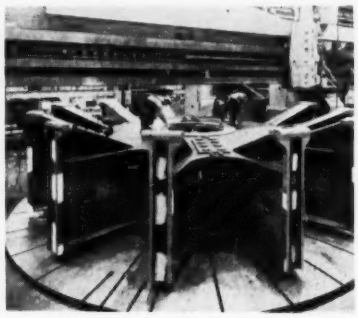
Reports from the field

Begins on page 158

heat source with a highly efficient thermoelectric conversion system on anything more than a laboratory scale. The compact generator will produce electricity during its lifetime equal to that furnished by nickel-cadmium batteries weighing almost 300 times as much.

The Martin Company is now at work on a 100-w generator using the same basic principle, with Strontium-90 for fuel. An advanced unit of this type, the size of a kettle drum, could supply power for a decade without servicing or refueling. SNAP-111 was developed under the auspices of the AEC.



Waterwheel generator for Niagara nears completion

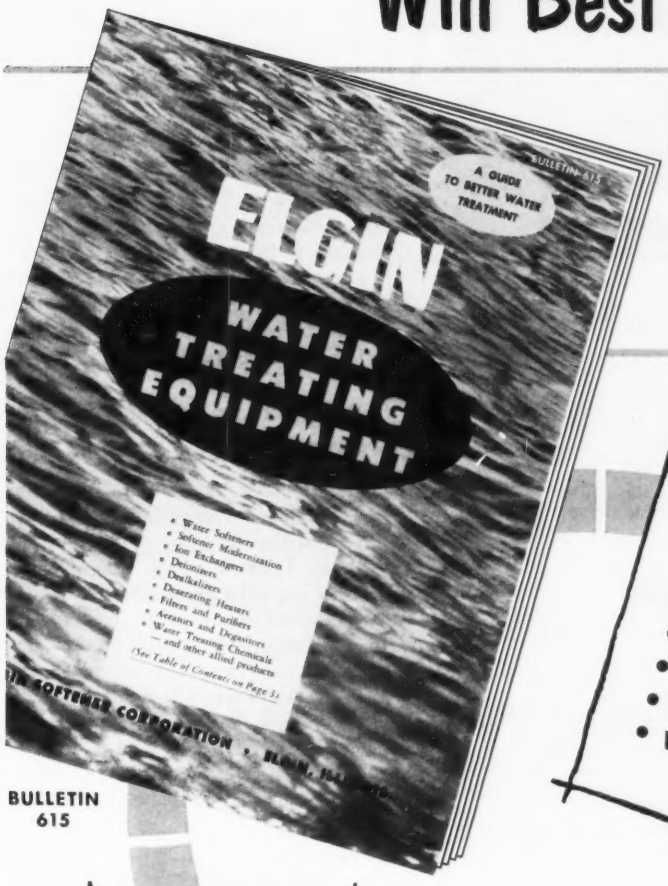
First of thirteen 167,000-kva waterwheel generators for the $720 million New York State Authority's Niagara power project nears completion, above. Niagara project will be the largest hydro development east of the Mississippi, second largest in the United States — only Washington's Grand Coulee has greater capacity.

Shipment of the parts for one 120-rpm generator, not including waterwheel, will use 34 railroad cars. Installation of the first unit is scheduled for 1960.

Air-conditioned worms dangle livelier

Life of a fish in Georgia, always on the short and merry side, may now be in greater jeopardy than ever. U.S. Worm and Minnow Hatchery in Cordele is producing air-conditioned worms, a stronger superworm species destined to lure even more poor fish

Which Water Treating Equipment Will Best Fit the Job?



BULLETIN 615

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If you are confused about the many ways to treat water, this new bulletin will help you decide which is best for the job. It describes the various equipment used in treating water and what each is designed to do. Known for quality, dependability and advanced design, this equipment is based upon 50 years experience. For practical guidance in its proper application, the services of the Elgin representative nearest you is yours for the asking.

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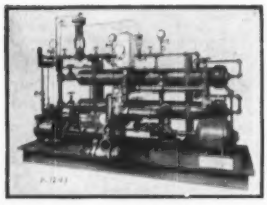

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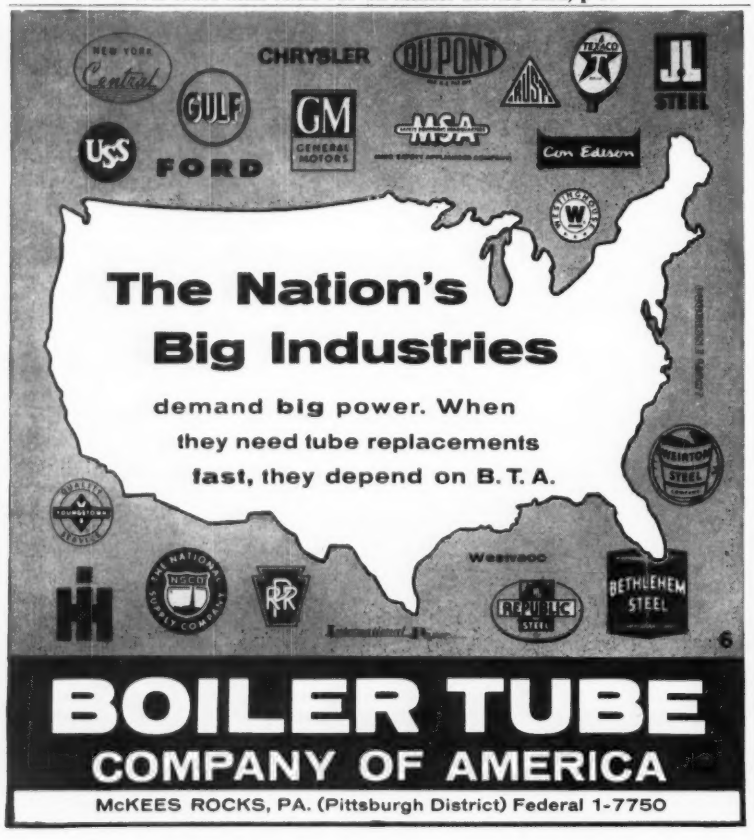
NATIONAL AIROIL makes a complete line of Fuel Oil Pumping and Heating Units for preparing heavy fuel oil for combustion for all types of Oil Burners. Illustrated is a compact, space saving Unit for 2000 Boiler H. P. installed in a large Meat Packing Plant.

Send for Bulletin No. 40 which illustrates and fully explains our wide variety of Pumping and Heating Units.

National Airoil
BURNER COMPANY, INC.
Main Office & Factory: 1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT
For more facts circle 313 on Reader Service card, p 99



BOILER TUBE
COMPANY OF AMERICA
McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

Reports from the field

Begins on page 158

into the frying pans of our nation.

Cooled worms grow faster, reproduce quicker and dangle livelier, say the growers. They're producing over two million wrigglers per annum at present. With cooling, worms are ready for the hook in half the normal time—21 days. But if it gets too hot, too cold, too damp or too dry the temperamental worms disappear, giving air-conditioning engineers headaches as they go. Temperatures and humidity conditions are trade secrets, but we can count on bigger, even better worms in the future, according to worm men in the know.

Biggest Latin American hydro plant to start up

BONN (*McGraw-Hill World News*)—The 420-mw Venezuelan power plant Caroni-Macagua has started operations. Located at the Caroni Cataracts, six miles before the Rio Caroni joins the Orinoco in the Amazon network, the plant cost $60 million.

Plant consists of six aggregates of 70,000-kva each. The 3-phase generators were supplied by AEG, turbines by the German firm Voit, transformers by a Swiss company, Oerlikon. First generator started early this May and last two will be in operation by year's end.

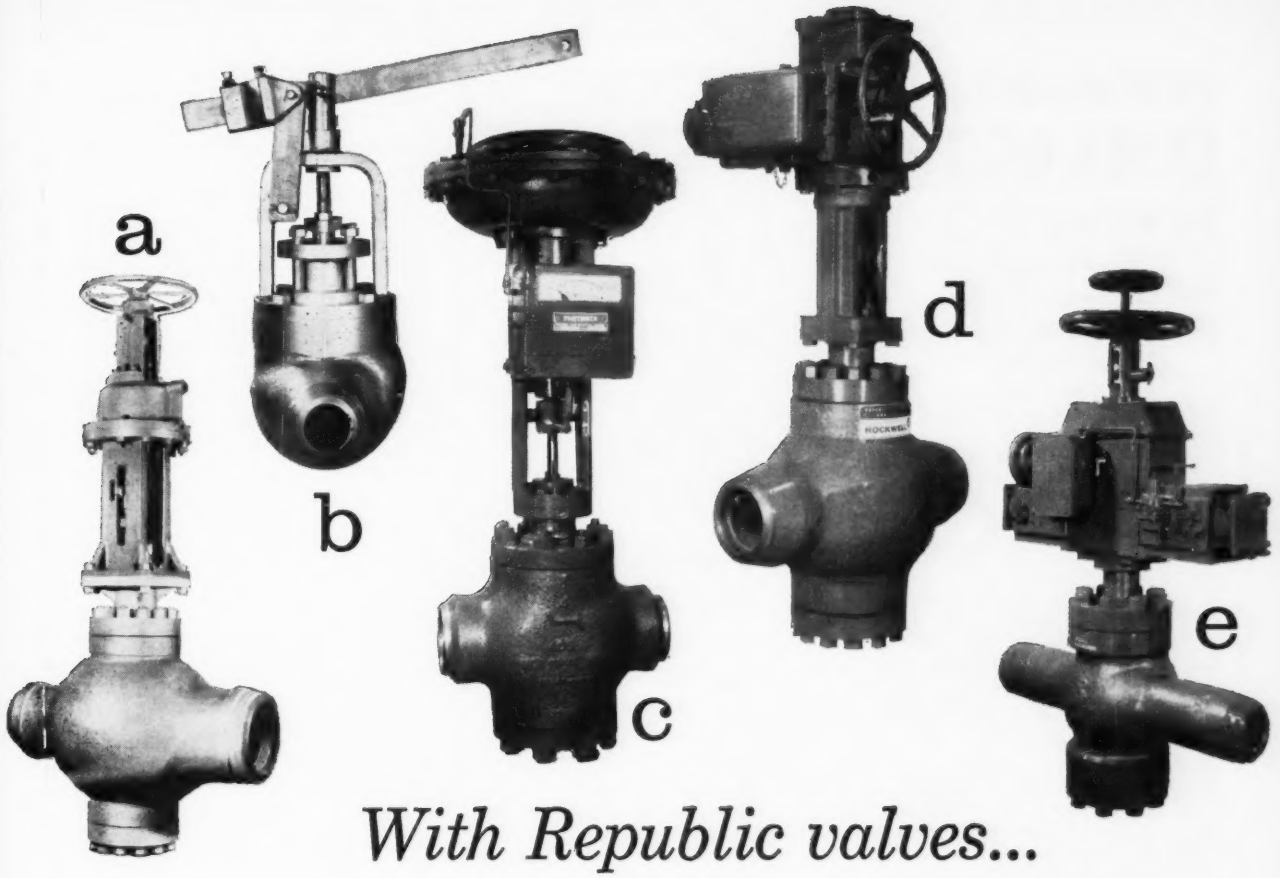
Plant was built to supply a neighboring steel and rolling mill, still under construction. It will also supply electricity to the provincial capital, Ciudad Bolivar, and to a large metallurgical plant on the Orinoco. Later it will electrify the oil region of Maturin, El Tigre and San Tome.

High-power test lab to increase capacity

Gearing up to test more large power circuit breakers, the Westinghouse Electric Corporation's high-power testing laboratory at East Pittsburgh, Pa. will be expanded in a $3,000,000 program.

Construction begins this summer, adding about 20,000 sq ft to the present facility. With the short-circuit capacity of electric utility systems doubling every ten years an expanded lab is needed to keep up with supply and demand, company officials state.

For more facts circle 314 on Reader Service card, p 99
circle 315 on Reader Service card, p 99 ➤



With Republic valves...

You get longer life, less maintenance

For over 35 years Republic valve developments have paced the changing demands for more sturdy valves by the most progressive utilities and industries. For such services as pump recirculation control, feedwater regulation, steam pressure reducing and high pressure water control, Republic valves have established a reputation for durability, long life and trouble-free performance.

Superior valve design—Republic research into the causes of valve noise and vibration, and also the wear resisting and galling properties of materials has resulted in a modern line of Republic valves of advanced design. Republic valve contours are designed to produce not only the desired regulating characteristics but also to reduce erosion damage and noise as well. Extra large guide bushings, extra deep stuffing boxes, solid plug inner valve construction, plus precise manufacture and long-life materials make Republic regulating valves perform better, last longer, with less maintenance.

Wide selection of valves and features—Rockwell-built Republic regulating valves shown on this page are representative of the complete Republic line:

a. **Cylinder operated valve**
b. **Lever operated valve**
c. **Diaphragm operated valve**
d. **Motor operated valve**
e. **Toggle head operated valve**
f. **Diaphragm operated angle valve**

And, for many special applications, such Republic accessories as pneumatic and electric valve positioners for hysteresis-free control, and a complete line of controllers are available.

Whatever your regulating valve problem, let Republic engineers put their years of application experience to work for you. For additional information, see your Republic representative, or write to Republic Flow Meters Company, 2240 Diversey Parkway, Chicago 47, Illinois.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

NEW BIDDLE

DIELECTRIC TEST SET

5KV-1MA

Maximum Output Current 5 MA at Output Voltage up to 4 KV

PORTABLE MODEL

This newest addition to the complete Biddle line of dielectric testing equipment has been specially designed for step-voltage resistance tests, voltage withstand, and breakdown tests on the insulation of such equipment as

- **rotating electrical machinery, dry-type transformers, switchgear, capacitors and insulators rated from 230 to 500 volts**
- **traction motors and generators**
- **wiring and cable installations**

Compact portable set is housed in shock and wear resistant case for severe field use in testing reconditioned equipment after installation, as well as for preventive maintenance of installed equipment. Also available in a bench model for making acceptance and proof test on electrical insulating systems for quality control in manufacturing and repair. For complete description, specifications and prices, WRITE FOR BULLETIN 22-5-P.

- **High Maximum Output Current**
- **Suitable for Impulsing Faults**
- **Efficient Performance even in Humid Atmosphere**
- **Full-Wave Dry-Type Rectifier Assures Long Service Life**
- **Protected Against Damage by Short-Circuit at Maximum Output**
- **Built for Rough Handling in Field Service**
- **Available in Portable or Bench Models**

BENCH MODEL

B911

JAMES G. BIDDLE CO.

Electrical Testing Instruments • Speed Measuring Instruments
Laboratory & Scientific Equipment
1316 ARCH STREET, PHILADELPHIA 7, PA.

Appointments

Corporation changes

Crane Co: Thomas Evans, chairman and chief executive officer. **Clark Bros Co:** F W Laverty, president; J N Mackendrick, board chairman; C P Clark, honorary chairman; J J Rosecky, executive vice-president. **Western Precipitation Corp:** A W Knight, president. **The Ames Iron Works, Inc:** I Tachna, president; J E Murray, vice-president and general manager.

The H K Ferguson Company: W T Webster, director of Pulp and Paper Div; R A Langworthy, director of Power Plant Div; J M Chambers, assistant director of Chemical Div. **Whitehead Metals, Inc:** E W Lothman, senior vice-president.

Stone & Webster Canada Ltd: G H Curtis, vice-president. **Combustion Engineering, Inc:** S R Parry, vice-president of manufacturing; R M Hatfield, vice-president and general sales manager in charge of domestic sales (reporting to D S Walker, vice-president and sales director.)

Dodge Manufacturing Corporation: J E Otis Jr, board chairman; J A MacLean, president.

Operations changes

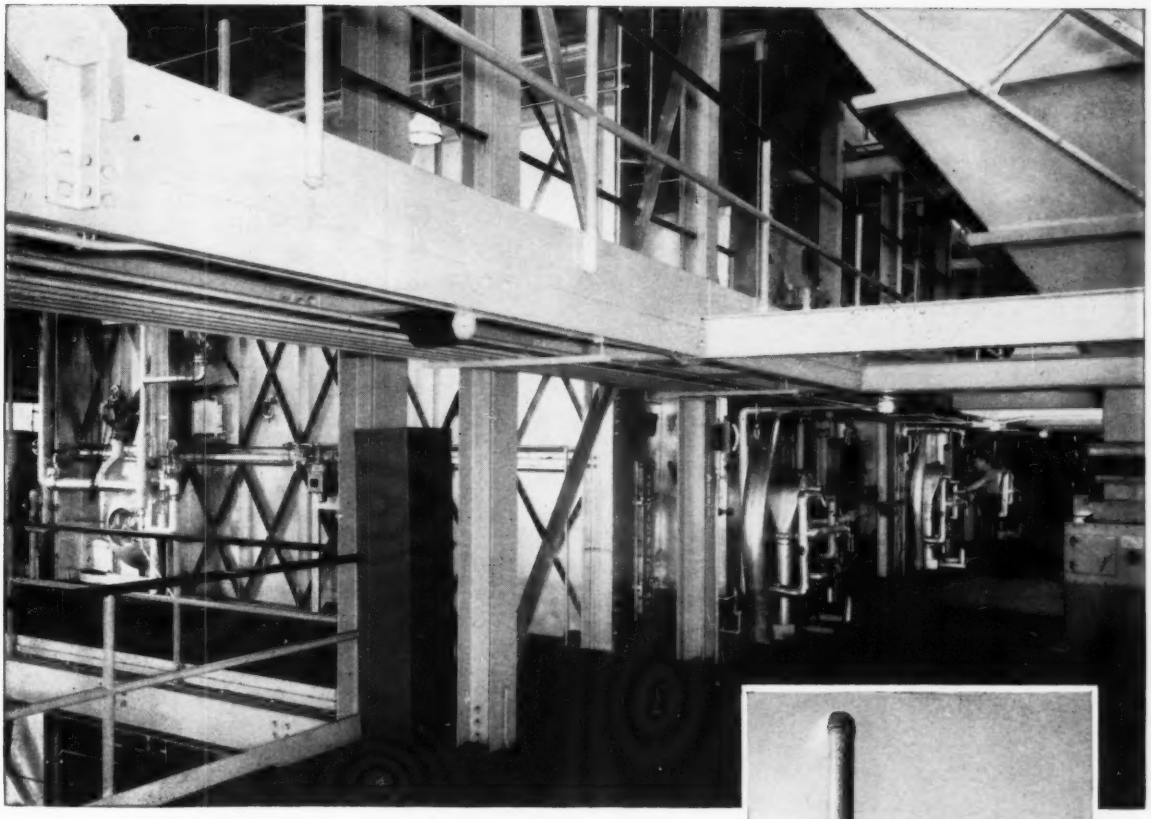
Stone & Webster Engineering Corporation: M H Cutler, engineering manager; T A Fearnside, assistant engineering manager; F F Dedrick, chief mechanical engineer.

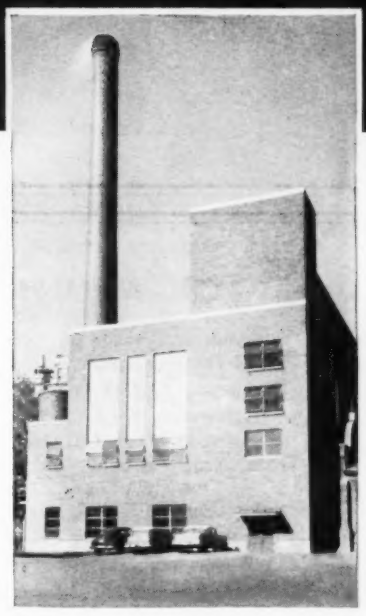
The Youngstown Sheet and Tube Company: Leo DeFiore, director of engineering; C J Lucas, chief engineer. **Fairbanks, Morse & Co,** Diesel Div: S K Howard, manager. **Worthington Corporation,** Air-Conditioning and Refrigeration Div: A J Hackl, general manager.

The Fluor Corporation, Ltd: William Thompson, chief inspector. **Hydromatics, Inc,** Pacific Div: F W Trebes, general manager. **Union Steel Corporation:** Dr R W Gurry, head of Research and Development Dept.

Consultant changes

I-T-E Circuit Breaker Company: J P Wood, power-equipment consultant. **Allis-Chalmers Manufactur-**





FIELD REPORT: ESSEX COUNTY HOSPITAL

3 Union steam generators post 86.46% efficiency

75 buildings spread over 553 acres . . . nearly 4000 patients and 1300 employees . . . briefly, that's the physical size of New Jersey's Essex County Hospital Development.

Consisting of two complete divisions — Overbrook Hospital and the Tubercular Sanatorium — the institution relies on three Union Type VO Steam Generators as its sole source of heat and power. Steam is dependably produced to drive a pair of 1000 KW turbine generators, to heat all buildings (some are a mile and a half away), to power the hot water circulating pumps, and to meet cooking, water treatment and deaeration requirements.

With unit capacities of 50,000 lbs./hr. at 300 psig and 460°F, these 2-drum boilers tested out at 86.46% efficiency.

Across the nation, Union Steam Generators are providing dependable, low-cost steam for industrial, institutional and public power plants. Long engineering experience, skilled shopmanship and traditional Union quality are the unwritten specifications that assure their top performance.

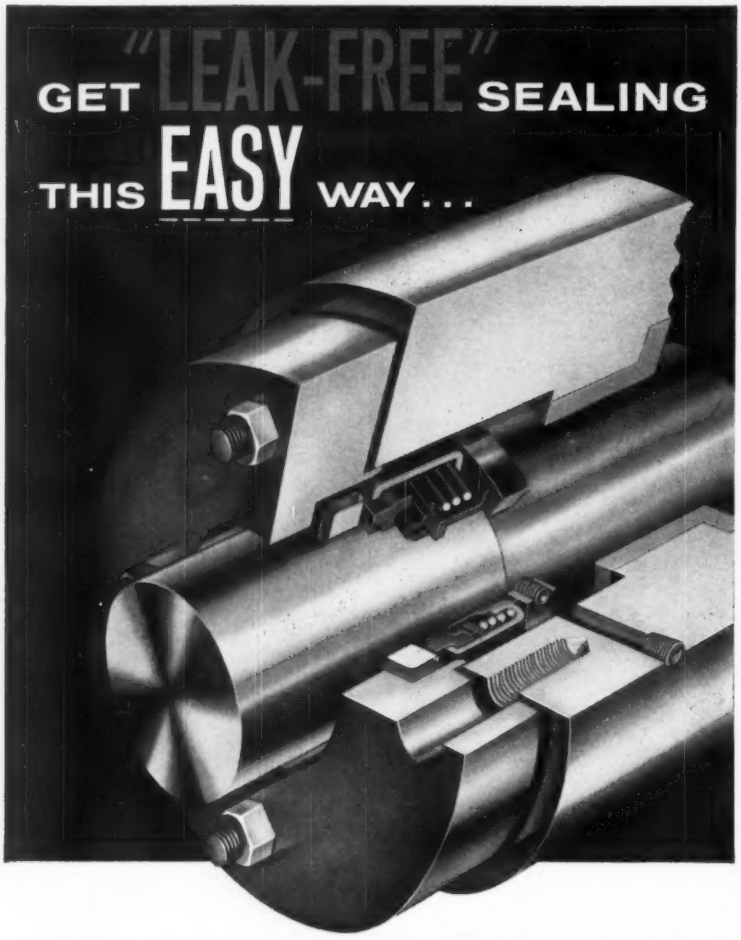
FULL INFORMATION on the many types and sizes of Union Steam Generators is contained in illustrated Catalog GB-958. Write for your copy.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA

For more facts circle 317 on Reader Service card, p 99



GARLOCK MECHANICAL SEALS

Easy to install—Garlock's PK MECHANIPAK* is self-contained—no parts to "put together." Rotating portion simply slides onto shaft; stationary portion positions quickly into counterbore of gland.

Easy to maintain—Once Garlock's PK MECHANIPAK is installed, further adjustment is unnecessary. No parts of the seal move on the shaft or sleeve, eliminating wear on shaft . . . spring in seal maintains contact between sealing faces.

Easily cuts costs—Garlock's PK MECHANIPAK is designed to reduce maintenance and downtime, thus offers many dollar-saving benefits.

Available in shaft sizes from ⅜" to 3" . . . will operate at temperatures to 212°F, pressures to 150 psi, shaft speeds to 2000 fpm. PK MECHANIPAK Seals are another important part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. Find out more from your local Garlock representative, or write for Catalog AD-150.

*Registered Trademark

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Canadian Division: The Garlock Packing Co. of Canada Ltd., Plastics Division: United States Gasket Company

Appointments

Begins on page 170

ing Company, General Products Div, West Allis pump dept: H P Binder, consultant. **C H Wheeler Manufacturing Company:** S M Arnow, consulting engineer.

General sales manager

B-I-F Industries, Inc: W L Sammons, general sales manager. **Canton Stoker Corporation,** Wagener Pump Div: J K Sloan, sales manager. **Beckman Instruments, Inc,** Scientific and Process Instruments Div: R F Brown, sales manager.

Clayton Mark & Company: R W Gronauer, sales manager, industrial fittings. **Crane Co:** C E Watson, general manager of atomic-energy sales; D R Nordwall, general manager of branch sales; C H Lovelace, general manager of engineering sales; R W Lindsay, general manager of wholesaler sales. **Sylvania Electric Products Inc,** Sylvania Lighting Products Div: Harold Barnum, utility sales manager.

District sales manager

The Babcock & Wilcox Company: R W Deuster, European nuclear-sales representative. **The Philip Carey Mfg Company:** R D Williams, California district. **The Jeffrey Manufacturing Company,** Industrial Div: W K Myers, eastern region; E F Longnecker, central region; V L Ekblad, southern region.

Graver Tank & Mfg Co: W H Dwyer Jr, manager of midcontinent and Gulf Coast sales. **The Philip Carey Mfg Company:** N D Musser, Dallas district. **Beckman Instruments, Inc,** Scientific and Process Instruments Div: J A Challacombe, midwest; G A Green, east.

Clark Bros Co: E G Hotze, southwest; J Y Allen Jr, Houston district; J R Hutton, Louisiana-Mississippi district. **The Ceilcote Company:** J G Galloway, eastern sales manager; T D Skaggs, southeastern manager.

Cleaver-Brooks Company: T B Mansfield, midwest; R D Pennstrom, northeast. **Clark Controller Company:** W J Backus, Cincinnati office. **The Okonite Company:** J R Haden, Kansas City; T M Brickley Jr, Milwaukee. **Republic Manufac-**

Marsh Mastergauge

...the gauge that has everything!

LEAK-PROOF ONE-PIECE CONSTRUCTION from socket to tip of bourdon tube...accomplished by the exclusive Marsh "Conoweld" process.

STURDY "MARSHALLOY" CASE formed of boiler-plate thickness steel, copper clad inside and outside by "Marshalloy" process to give it all the durability and the corrosion resistance of solid copper with the dependable strength of steel.

SUPERLATIVE "MASTERGAUGE" MOVEMENT with exclusive "coined" sector gear, self lubricating, frictionless action and other refinements that add years to service life.

TYPES FOR EVERY SERVICE...wide range of bourdon tubes including stainless steels and monel. Full range of pressures, vacuum, compound gauges in endless sizes, case styles. Only Marsh has the "Safecase" for dangerous gauge applications.

"Mastergauge" is standard bearer for the broad line of Marsh Gauges fully covered in Catalog 76-G. All are available with the "Recalibrator"—best way to correct a gauge that has been knocked out of adjustment.

MARSH INSTRUMENT CO.
Sales Affiliate of Jas. P. Marsh Corp.,
Dept. F, Skokie, Illinois
Marsh Instrument & Valve Co., (Canada) Ltd.,
8407 103rd St., Edmonton, Alberta, Canada

MARSH

"THE STANDARD OF ACCURACY"

GAUGES • DIAL THERMOMETERS • REFRIGERATION INSTRUMENTS • HEATING SPECIALTIES

For more facts circle 319 on Reader Service card, p 99

Good Pair to Know!

Chances are you won't have to look far to find a spot for one of these float-operated switches.

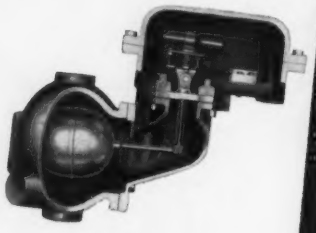
They have been specially developed by McDonnell to serve two broad fields of application. They answer a lot of operating problems that you may have thought could be handled only by make-shift or much more expensive equipment.

Dependable and time tested, they are just two of hundreds of products developed by McDonnell for liquid level or liquid flow control. When you choose from the complete McDonnell line it's good to know you draw on unmatched experience and know-how in this specialized field.

McDonnell No. 65
Explosion Proof Electric Controller

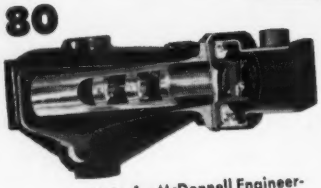
Underwriters' Listed for use in hazardous locations:
Class 1, Group C & D
Class 2, Group F & G

A float-operated switch for use under hazardous conditions, such as atmospheres containing butane, benzol, lacquer solvent, alcohols, acetone, coal and grain dust, etc. Can be furnished to make or break electric circuit at high- or low-level — to control motors, signal lamps, electric elements, etc. Suitable for internal pressures up to 40 psi.



Write for McDonnell Engineering Bulletin ERS-10 which discusses typical applications of No. 65, shows wiring diagrams for different patterns of operation.

McDonnell No. 80
High- or Low-Level Switch



Underwriters' Listed for use on oil tanks.

A float-operated three-terminal switch that can be used to provide high- or low-level alarm, or to start or stop a pump when level rises or falls. It makes possible reliable automatic control in place of gauge glass watching and manual control.

Write for McDonnell Engineering Bulletin ERS-9 which shows typical application of No. 80 on oil storage tanks, complete with wiring diagrams for draining or filling tanks, high- or low-level alarm, signal or cut-off.

Write for complete literature and engineering bulletins.

McDONNELL & MILLER, *Inc.*, 3506 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

REG. U. S. PAT. OFF. SAFETY CONTROLS

Your Jobber Stocks Them

McDONNELL

BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS

Appointments

Begins on page 170

turing Company: Don Finlayson, Chicago. **Worthington Corporation:** C D Wood, Boston district.

New names

Computer Sciences Corp: new Los Angeles firm to serve computer users and manufacturers in scientific and data-processing work; Fletcher Jones, president, Roy Nutt, design and development director, R L Patrick, director of applications programming.

The Dayton Industrial Products Company: new division of The Dayton Rubber Company. **Triangle Conduit and Cable Co, Inc:** new Bituminized-Fiber and Plastic Pipe Div.

Nalco Chemical Company: new name for National Aluminate Corporation. **Computer Systems, Inc:** name change for Mid-Century Instrumatic Corp. **Kiely Fletcher and Associates:** new name for D J Kiely Jr & Assoc; P W Fletcher, partner.

Institute elections

Air Pollution Control Association: A Arch, executive secretary.

American Society of Lubrication Engineers: Dr A B Wilder, E I duPont Co, president; J D Lykins, Wheeling Steel Corp, chairman of presidential council; L O Witzenburg, Farval Corp, vice-president at large.

Industrial Research Institute, Inc: Dr R W Cairns, president; R G Chollar, vice-president and president-elect.

American Society for Metals: A R Putnam, managing director.

American Society for Engineering Education: Dr B R Teare Jr, Carnegie Institute of Technology, president.

Obituaries

John B Hendrickson, founder and chairman of the board of Welding Engineers, Inc, on May 1st.

Leon T Mart, board chairman of The Marley Company, on May 17th.

Arthur Robert Weismantle, manager of contract planning, Foster Wheeler Corporation, Equipment Div, on March 9th.

Citric Acid -- Dowell's New Service for Cleaning Stainless Steel Process Equipment

Now, for the first time, plant operators can be sure of a new degree of safety in the cleaning of their pressure units containing austenitic stainless steel—for example, heat exchangers, stainless-clad pressure vessels, atomic reactors, and supercritical-pressure steam generators. Citric Acid service by Dowell provides a new, effective method for these special chemical cleaning situations.

The Citric Acid used in Dowell chemical cleaning is inhibited with an *exclusive chloride-free* inhibitor. Cleaning with this new field-proven solution assures a chloride-free solvent system, and thus helps prevent chloride stress-corrosion cracking.

Dowell Citric Acid also provides other significant advantages: Citric Acid stabilizes dissolved iron and helps prevent precipitation of insoluble iron compounds when neutralizing chemicals are used. Flushing of the unit is not as difficult when Citric Acid is used. Citric Acid is especially suitable where stainless steel and other metals are used together in construction of the unit.

Citric Acid cleaning with a chloride-free inhibitor is just one of the new ideas from Dowell research. Other recent contributions include the new "white glove" standards of cleanness, copper removal agents and the new jetting device for cleaning heat exchanger tube bundles.

Ask your Dowell representative about Citric Acid service and Dowell chemical cleaning programs for your plant equipment. Dowell, the leader in chemical cleaning service and research, operates in every major industrial area through 165 offices and stations. Dowell, Tulsa 1, Oklahoma.

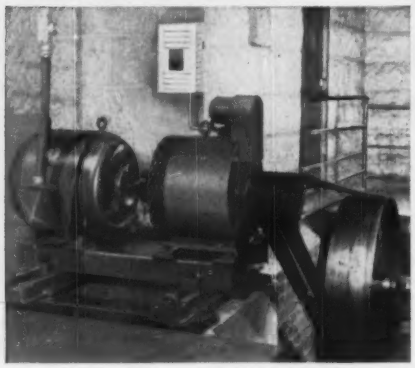
Chemical cleaning service for all industry DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

For more facts circle 321 on Reader Service card, p 99

GOT A SPEED CONTROL PROBLEM?

HERE'S HOW OTHERS SOLVE IT THEMSELVES WITH E-M AMPLI-SPEED DRIVE

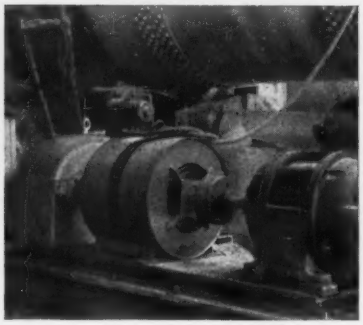


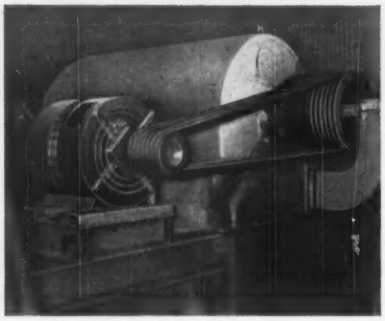
SOLVES VENTILATING FAN DILEMMA

Problem: When power in a large Minnesota building was converted from d.c. to a.c., five giant ventilating fans, formerly powered by adjustable speed d-c motors, had to have new a-c drives. **Solution:** They installed induction motor-driven E-M Ampli-Speeds. **Result:** A low-cost change-over plus a definite power saving advantage. The fans are controlled at speeds of 0-170 rpm.

IMPROVES CEMENT KILN OPERATION

Problem: Operators of a California cement plant wanted to adjust revolving cement kiln speed accurately for highest quality output. But speed of installed wound-rotor motor could only be changed in steps. **Solution:** The company replaced it with an E-M Ampli-Speed Magnetic Drive coupled to an existing induction motor. **Result:** Exact, smooth speed control over a wide range; higher quality cement; and increased output.





PERFECTS PAINT MAKER'S CENTRIFUGE

Problem: To separate various sized particles of pigment, a Georgia paint manufacturer varied his centrifuge speed with an adjustable pulley device. But the speed still tended to "drift" and made accurate particle separation impossible. **Solution:** He replaced the pulley device with Ampli-Speed. **Result:** Stepless, pin-point control of centrifuge speed between 190-640 rpm, giving accurate particle separation. Drifting is held to ±2% by Ampli-Speed's automatic speed control system.

DO IT YOURSELF WITH AMPLI-SPEED

Remember, you don't need costly engineering or factory technicians to install Ampli-Speed. Your own plant electrician can do it.

E-M

Write the factory now for informative literature showing how Ampli-Speed can solve your speed control problem. Ask for Bulletin 1126.

4400-TPA-2191

ELECTRIC MACHINERY MFG. COMPANY

Minneapolis 13, Minnesota

Somewhere in your plant an operation can be improved with smooth, adjustable Ampli-Speed Drive

Bookshelf

Air Pollution Control. *By W L Faith, Managing Director of the Air Pollution Foundation, San Marino, Calif. 259 pp, illust, $8.50. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

Basic facts that must be considered in any air-pollution program, voluntary or required by law, are presented in this brief account. Written for the technical nonspecialist or the interested layman, the book investigates all important phases of air pollution: its effects, influence of the weather on it, methods of measuring air contaminants, applicable control methods, related legal problems. The newer problems of automobile exhaust and radioactivity are described.

A list of contents indicates the scope of the book: the air-pollution problem; meteorology; smoke; dusts, fumes and mists; gases; odors; automobile exhaust; the air-pollution survey; legal aspects. An appendix of conversion factors for common air-pollution measurements and an index are included.

Lighting Handbook. *256 pp, 5¼x 7½, leatherette, $3.00. Westinghouse Electric Corporation, Lamp Div, Bloomfield, N. J.*

Modern lighting practices are covered in this pocket-sized manual. A fold-out page in full color shows the electromagnetic spectrum. Data on distribution and light measurements, a revised section on new light sources, coefficients of utilization and maintenance factors and footcandle tables are included. Application illustrations are useful for dealing with modern lighting problems.

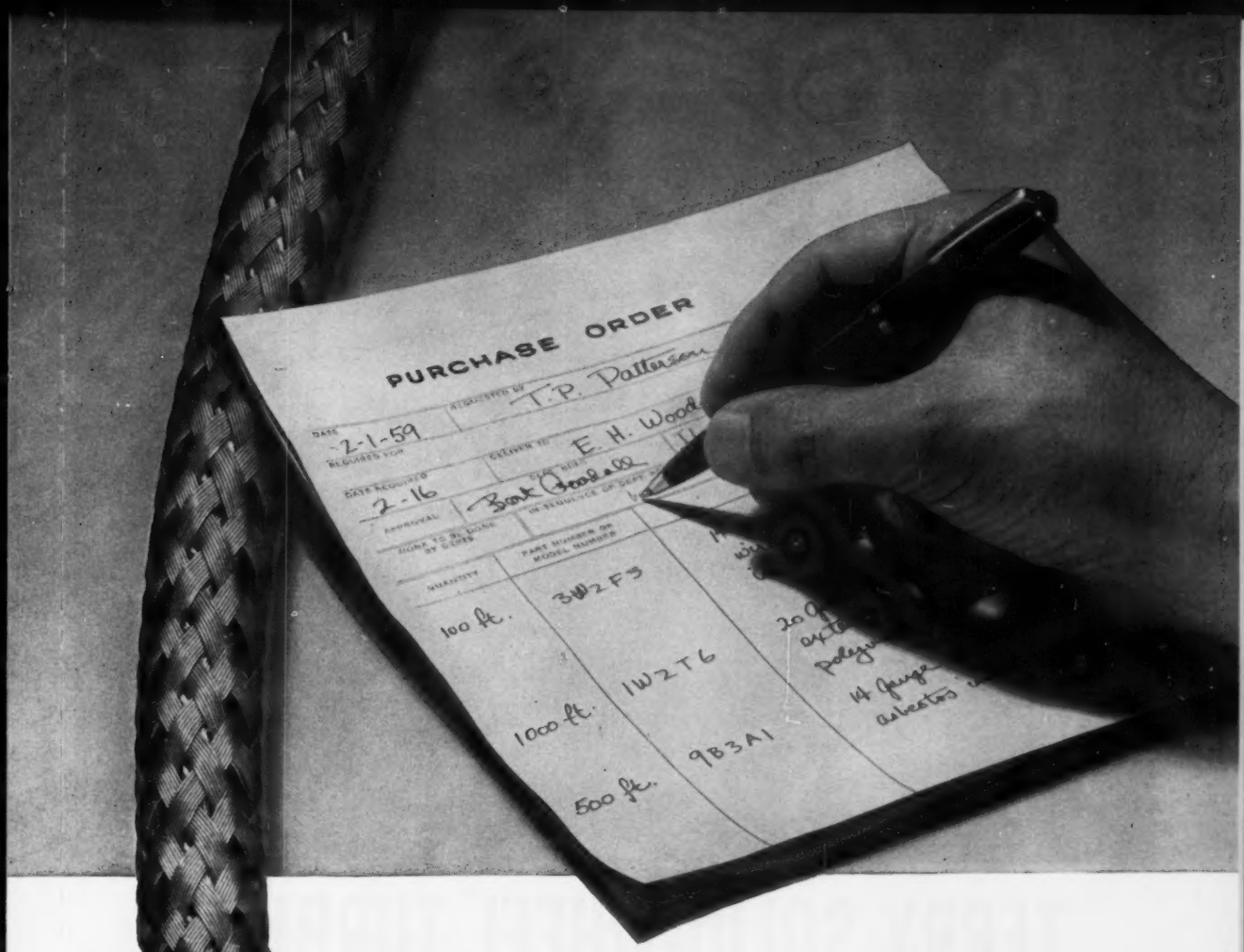
Manual also contains chapters on interior wiring; school and office, store, industrial and architectural lighting; floodlighting design; the cost of lighting.

Low-voltage hot-rail system for cranes uses rails on which vehicle runs as electric-power conductors.

Most powerful elevators are slated for Navy's nuclear-powered carrier, the Enterprise. They will ferry bombers, fighters to the flight deck.

For more facts circle 322 on Reader Service card, p 99

circle 323 on Reader Service card, p 99 ➤



Write your own ticket for Honeywell thermocouple wire

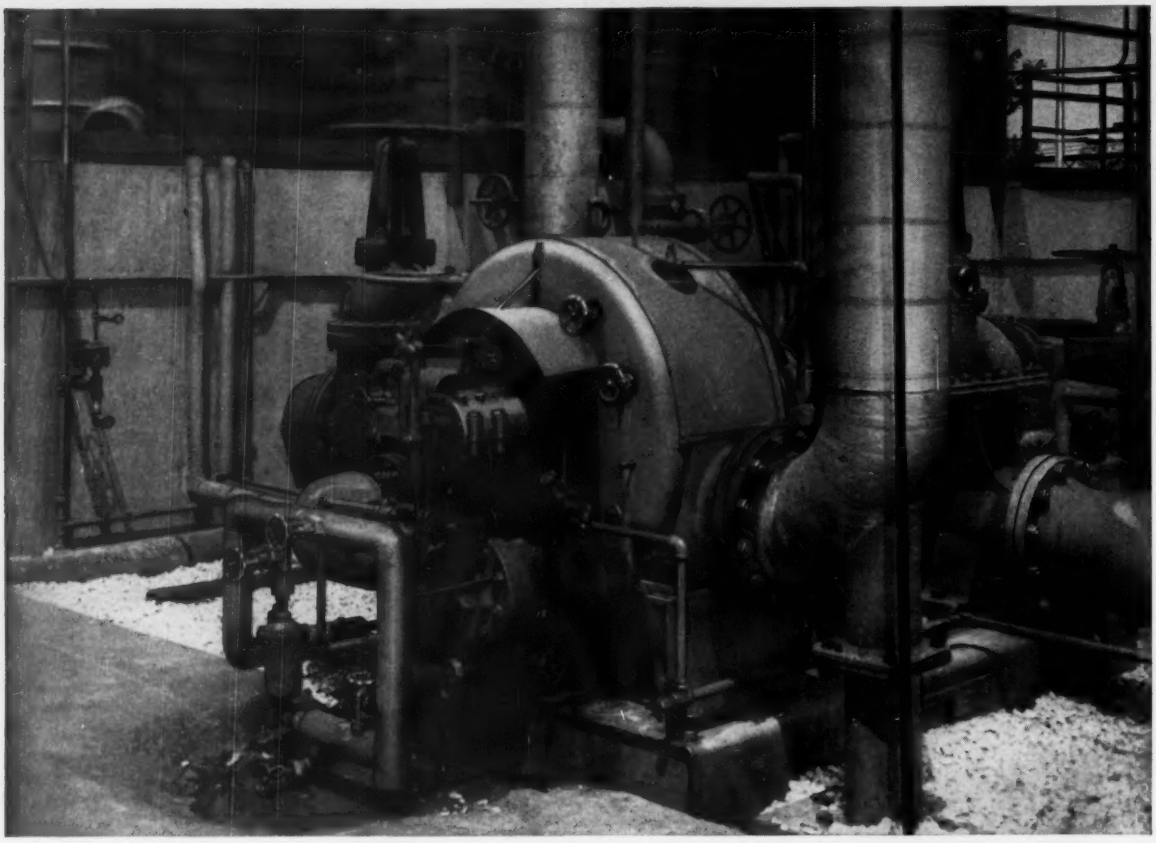
Choose from over 100 variations of insulated thermocouple wire and thermocouple extension wire. Honeywell can supply it from stock, with insulation in any of the conventional combinations of asbestos, glass, polyvinyl, Teflon and others. Should your application require other than conventional insulation, Honeywell can custom-make what you need, quickly and economically.

Call your local Honeywell field engineer . . . he's as near as your phone. Or write for Buyer's Guide C100-8.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

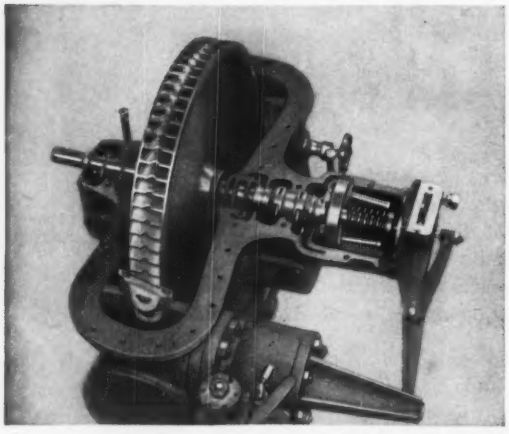
Honeywell

H HONEYWELL *First in Control*



TERRY SOLID-WHEEL TURBINES

used exclusively at Baton Rouge plant of W.R.Grace & Co.



The upper photograph shows one of the 17 Terry turbines installed at the Baton Rouge, La., GREX high-density polyethylene plant of W. R. Grace & Co. Above, a typical Terry solid-wheel turbine with cover removed to show the wheel construction.

In purchasing equipment for their new 50,000,000-pound high-density polyethylene plant, W. R. Grace & Co. standardized, wherever possible, on a single source of supply for each type of equipment used. Consistent with this policy, Terry steam turbines were used exclusively throughout the utility and process sections of the plant.

A total of 17 turbines were placed in service for driving pumps and fans. These are all of the solid-wheel type, ranging in capacity from 50 to 240 HP.

Terry solid-wheel turbines are known for their long life and sure dependability under the most-trying operating conditions. They feature a single-piece wheel which is virtually indestructible.

Send for details of these trouble-free turbines. Ask for a copy of bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1214

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This is for YOU!

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George Edwards

suggests a check of employee "outrages"

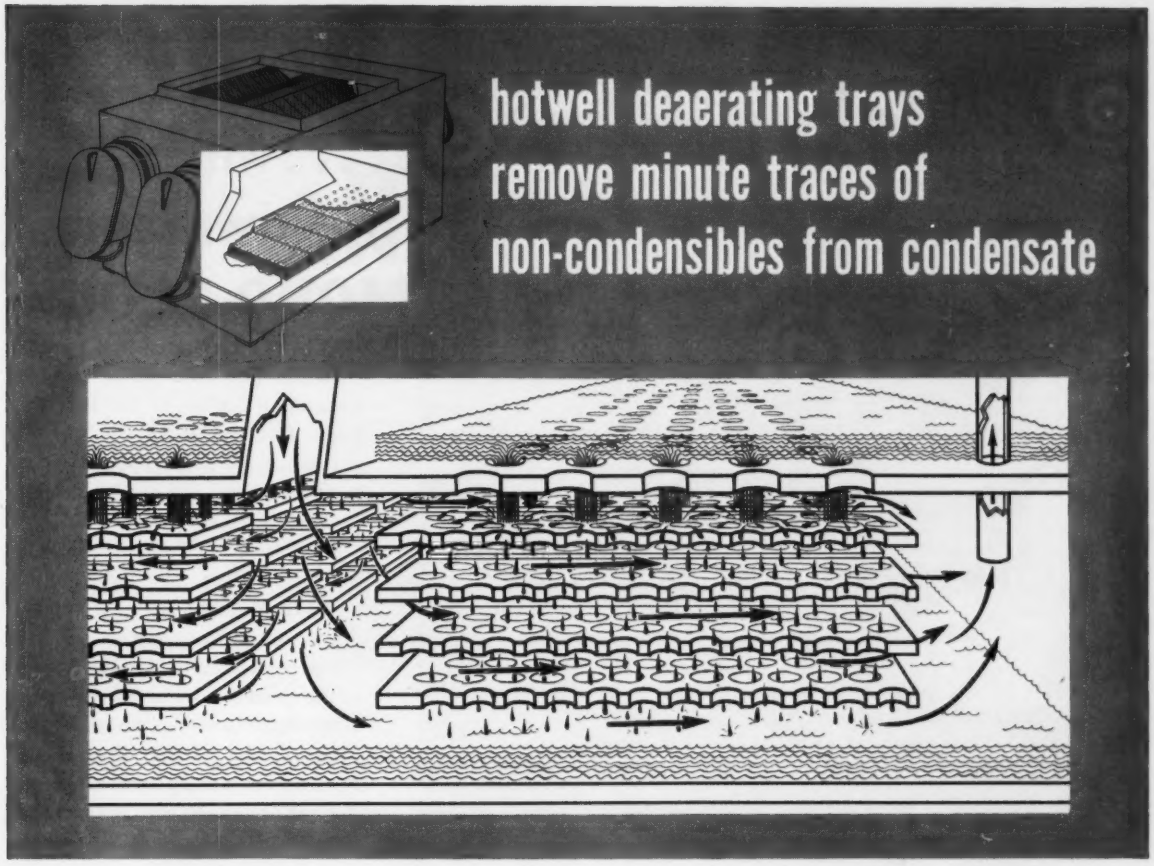
An epidemic of headaches swept through a group of sewing-machine operators who worked around a conveyor. The women, normally a productive bunch, more and more frequently developed "sick" headaches and had to go home. Some were off the job the next day. All this was very mysterious; the women themselves didn't know the cause but stated flatly that they were too sick to work. Production started to hit the skids. Management, more irritated than concerned at first, worried in earnest when the company doctor reported that the women weren't goldbricking. They were sick, no doubt about it, but he couldn't find anything organically wrong.

A prominent psychiatrist and industrial consultant was called in. He surveyed the situation, picked out the trouble spot. His explanation was simple: In making inspection rounds, foremen approached operators from the rear. This caused the women to feel uneasy. Tension built up in their neck muscles, produced the headaches. Somewhat skeptical, management tried the consultant's suggested remedy: Have foremen approach from the front and speak before reaching the point where their presence would be "sensed." It worked like a charm. Soon the headaches stopped and, as time went by, the girls began singing at their work. Absenteeism and reject rates took a nosedive.

I ran across this story in a book review in the June issue of McGraw-Hill's *International Management Digest*. The book, written by Dr Helmut Sopp, a West German psychiatrist and industrial consultant, deals with a subject that could stand a hard look by power-plant people on a supervisory level. His findings, says Dr Sopp, prove that unless basic needs are satisfied, employees may escape into absenteeism and even genuine illness.

Dr Sopp doesn't dwell on what we normally think of as "emotional problems," nor is he suggesting that we coddle the chronic griper, the job-hopper or the guy who always wants egg in his beer. He's saying that better human relations (and employee efficiency) are possible if management will apply more common sense, rather than "advanced psychology" and human-relations "gimmicks." He stresses, too, that small points can be vital.

Each employee in the average plant represents a husky investment when we consider the value of equipment the guy may be responsible for. We give this equipment plenty of protection in the way of preventive maintenance and "fail-safe" devices. Doesn't it seem logical that the employee should rate even more concern? He's a tremendously complex machine, it's true, and we still don't understand much about what makes him tick the way he does. But some things that throw him out of phase may be quite easy to correct. And it may be surprising how well results justify the effort involved in locating the fault.



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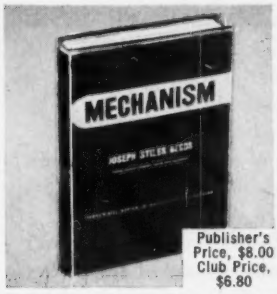

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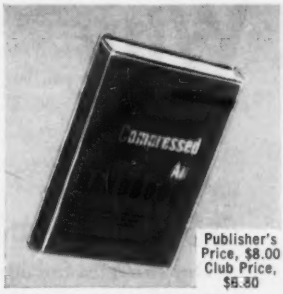

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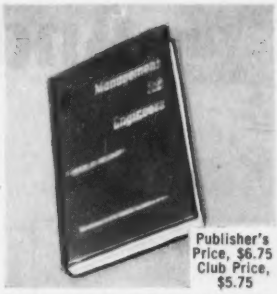

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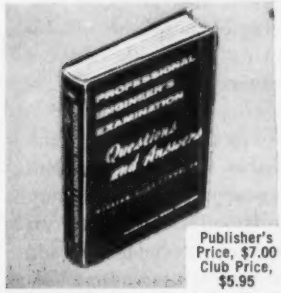

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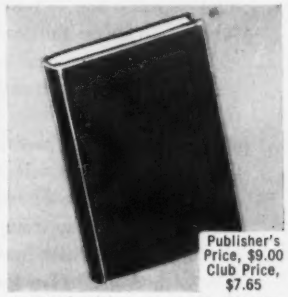

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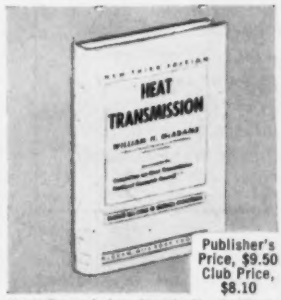

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P-7

A MESSAGE TO AMERICAN INDUSTRY • ONE OF A SERIES

One Battle We're Losing —And Why

Lest it seem self-serving, we of McGraw-Hill, as publishers, have hesitated to make the following statement about the "Battle of the Books." However, our reticence has been overcome by our conviction that it is greatly in the national interest to have much wider public understanding of the nature of this battle. This conviction is strengthened by the fact that many, not in the publishing industry, believe in the importance of this battle and, further, by the fact that it is a battle which the United States is losing.

The United States is losing an important battle — a battle of knowledge and ideas, waged with books. It does not have the excitement of competition in scientific achievement, nor the urgency of a diplomatic crisis, nor the obvious economic significance of a struggle for export markets. But our success or failure in this battle of knowledge and ideas may well have a decisive bearing on these more spectacular aspects of international rivalry.

The Russians know this. About a decade ago, they started a program to build up their export of books, the most durable and penetrating way of communicating knowledge and ideas. **By 1957 the Soviet Union was exporting 30 million books, one-and-a half times as many as the United States.** Many of these books are printed in English, and all are in languages of the non-Communist world.

In the languages of the Near East alone, the Russians printed and distributed 413,600 books in 1957, as compared with 166,415 in 1956. In India, Russian textbooks on engineering are to be published in English under a technical aid agreement signed in Moscow last December.

"Trade Follows The Book"

Books are in the advance guard of the Soviet political and economic challenge to the free world. With books go ways of thinking — about government, about education, about management, about science and technology. If these books do their job effectively in the training of those who will become a nation's leaders, they will provide the basis for political and cultural understanding and also, in the future, for trade.

The Russians are not the first to discover this relationship. Britain, which lives by trade, has traditionally exported more of its book production than any other nation. Today it exports one book in every two produced. The British have a favorite dictum: "Trade follows the book." They have proved its accuracy. Now the Russians are trying to make this same principle serve their purposes.

Where does the United States stand in this competition for men's minds? In number of books, it trails far behind the Soviet Union — exporting roughly 20 million books, against the Russians' 30 million. As a proportion of our total output of books, our exports amount to only 10% — against Britain's 50%.

The Russians' Advantage

U.S. book exports have grown in the years since World War II, from approximately $11,000,000 in 1946 to $35,000,000 in 1958 (both figures excluding Canada). But in expanding book exports, the American publishing industry faces two major obstacles:

(1) **The comparatively high cost of producing a book in the United States,** which puts its price well beyond the reach of many students, teachers and businessmen in other countries; and

(2) **The shortage of dollar exchange in many countries,** which means that importers can pay for

books only in currencies that are of little use to American publishers.

The Russians have neither of these problems. Soviet publishing is state-subsidized, and exported books are sold for nominal sums paid in the currencies of the importers. As these books serve the political and economic purposes of the Soviet Union, they are cheerfully sold on giveaway terms.

The American publishing industry, on its own, is making vigorous efforts to increase the distribution of American books in other countries. Leading U.S. publishers and their agents have offices and salesmen in the major countries of Asia, Africa and Latin America. Several publishers have begun to reprint textbooks in Asia at one-half to one-third of their U.S. costs, thus making them available to the students in Asian countries at prices they can more nearly afford. And the American paperback has become a symbol of low cost in popular books. But neither of these devices is practicable for serious cultural, technical, scientific, educational and professional books, which require durable, hard-bound and necessarily expensive editions. Despite their great importance to those who need these books, the demand for them is simply not large enough to warrant low-cost publishing methods.

Government agencies also have increased the availability of American books. The United States Information Agency and the International Cooperation Administration have placed American books in libraries overseas, donated them to educational institutions and presented them to key individuals in the industries and governments of the developing countries of the world. But these programs are small in relation to the need.

A Modest Program

An unusual and little-publicized Government program has helped American publishers overcome the other major obstacle to the export of books — the shortage of dollar exchange. This is the Informational Media Guaranty (IMG) program, administered by the United States Information Agency. It enables publishers of books judged to be worthy of the American way of life to sell their books, for local currency, in countries such as the Philippines, Formosa, Vietnam, Burma, Indonesia, Pakistan, Turkey, Israel, Poland, Yugoslavia, Spain and Chile, which would otherwise be unable to buy these books because of their shortage of U.S. dollar exchange.

The IMG program is not a giveaway. Publishers have to **sell** their books, and customers overseas have to want them enough to **buy** them at full prices. IMG merely guarantees that the exporting publisher receives in dollars the payments he collects from his customers in their currency. The program costs very little in terms of our total foreign aid program, or in terms of what it accomplishes. In ten years it has made possible the sale of $150 million worth of books, magazines and films to countries of key economic and strategic importance at a cost of only $10 million.

The IMG functions through a revolving fund. Foreign currencies are exchanged for dollars, and the foreign currencies in turn are resold to replenish the supply of dollars. The net cost is the small but unavoidable loss on resale of these foreign currencies. Over the ten years of this program, the IMG revolving fund has shrunk from its original $28 million to $18 million, $10 million of which is in unconverted foreign currencies.

If this modest but vitally important program is to be continued, Congress must appropriate the money necessary to rebuild the revolving fund. This would ensure that any country approved by the State Department and willing to sign an agreement to buy American books, at their full price, with its own currency, could do so. Last August, Congress reduced a requested appropriation for this purpose from $7 million to $2½ million. To continue even at its present reduced level, an appropriation of $3½ million is needed. To realize the full potential of IMG, the revolving fund must be restored to its original level.

If the IMG program is not continued, with adequate financial support, some countries whose friendship and understanding we seek today and with whom we hope to build a trading partnership in the future will have to reduce their purchases of American books to a trickle. These are countries where school teachers, college professors, students, engineers, doctors and businessmen need and want to buy American books. The loss will be not only theirs, but ours as well. For it will deprive the U.S. of one of its most effective, and least costly, means of communicating knowledge and ideas and understanding of the American way of life.

This message is presented by the McGraw-Hill Publishing Company to help increase public knowledge and understanding of an important national problem. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

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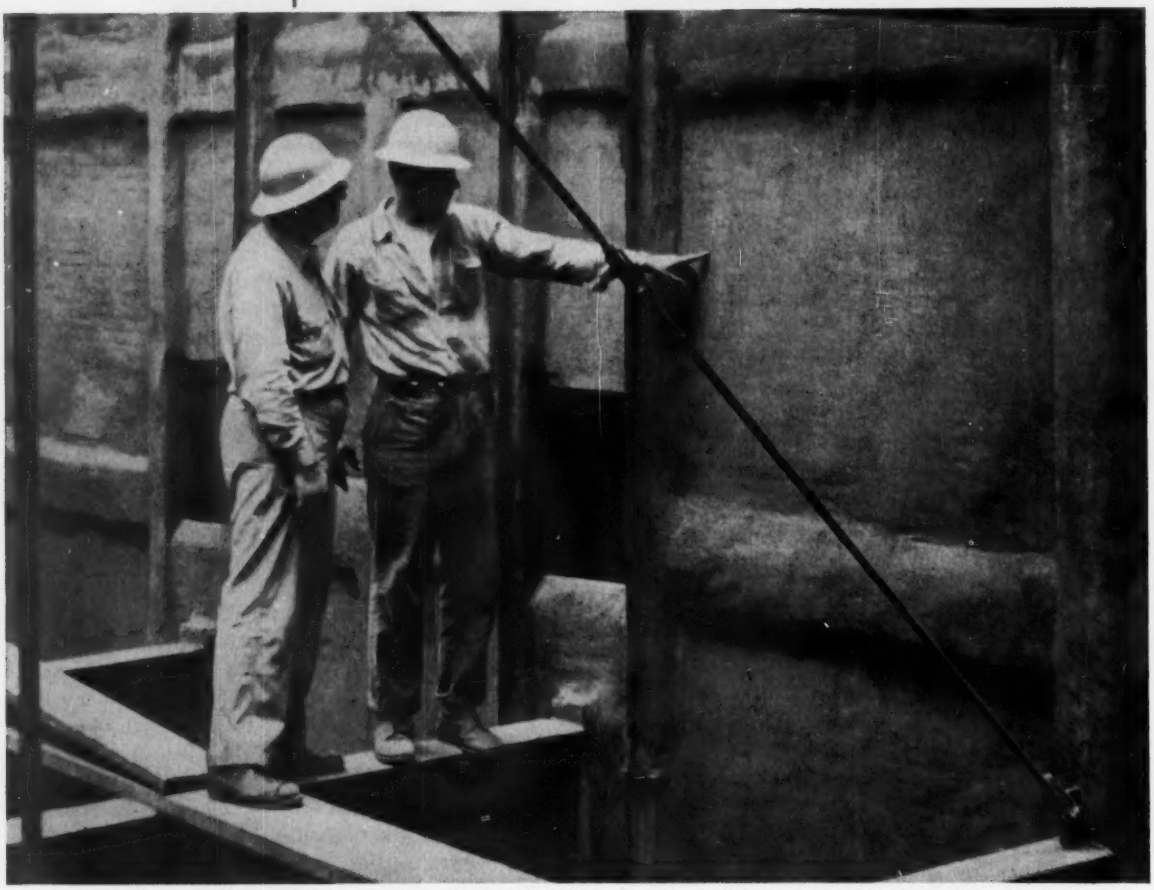

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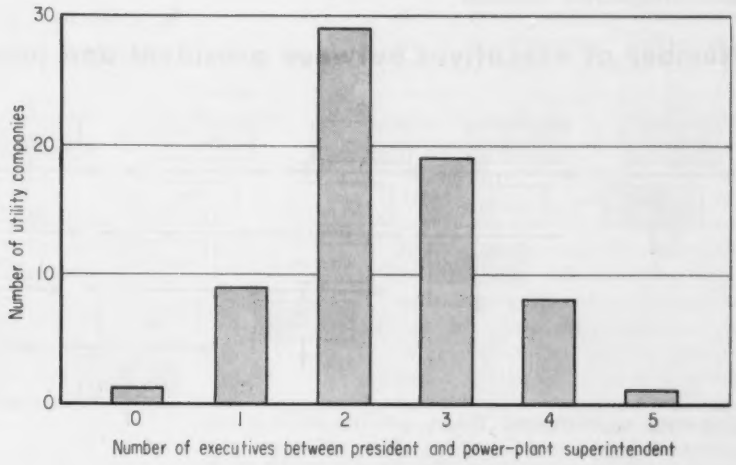
Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



Expanding territories, growing loads, multiplying duties in electric utility companies raise the question . . .

Has tradition downgraded the power plant superintendent?

Survey of 79 utility companies shows it's a long way to the top from plant superintendent to chief executive. Most manufacturing companies have only one intermediate executive between works manager and company president

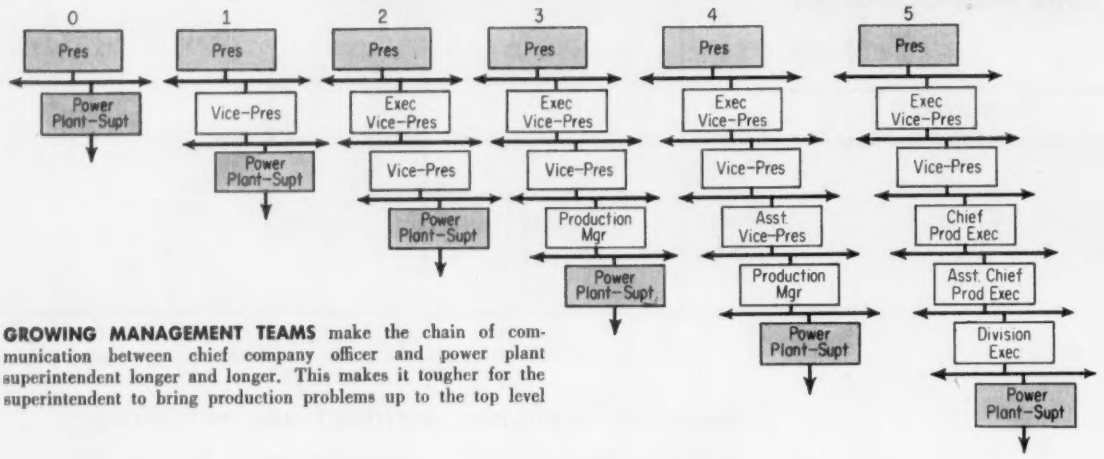
By GEORGE W PEAK, Director of Organization Planning
Public Service Company of Indiana, Inc

In our survey of the management organization of 79 electric utility companies we found 67 that clearly established the line of authority from plant superintendent to president. The bar chart, above, shows that in 57 of these firms there were two or more executives between the power plant superintendent and the president; in 28 of them there were three or more executives. This is an uncommonly long line of authority and communication for such an important function as energy generation—the principal product of the enterprise.

In most manufacturing companies outside the electric utility industry, the number of intermediate executives between the works manager and president is usually one, at most two. This contrasts sharply with the management setup of the utilities. Why this difference in length of line of authority? Why are works managers placed in higher executive stratas in industry than the plant superintendents in electric utilities? Let's look for the answers.

Historically the first electric power plants were small and could be run by a boiler plant operator. Management was relatively easy. As power plants grew into the giants of today, need for managerial skill grew

Number of executives between president and power-plant superintendent



GROWING MANAGEMENT TEAMS make the chain of communication between chief company officer and power plant superintendent longer and longer. This makes it tougher for the superintendent to bring production problems up to the top level

with them. But changes in the utility management organization to give higher responsibility to plant superintendents have lagged behind the level of managerial skill needed.

Automation. Electric energy production has long been automated to a high degree. This has held down size of the operating crew needed in today's power plants. On the other hand the average manufacturing plant in other industries needs a relatively large force of semiskilled operators and often a larger force of low-skill operators. The plant management job traditionally has been larger, as measured by the number of employees to be supervised, than in the average electric power plant.

Fixed processing. Once a power plant has been built, its processing cycle can only be changed at great expense. Effectiveness and operating economy of a plant are largely "built in" and the prevailing attitude assumes that operation practice has only a minor effect. In other manufacturing plants management skills can influence effectiveness and economy to a relatively great extent.

In an electric plant, material input, material processing and output of product are practically simultaneous. This eases the task of management and coordination of work-in-process, especially in comparison to the usual industrial manufacturing plant.

Single product. An electric power plant has only one main raw material (not several as in many factories), only one manufacturing process (not several), and only one product (not a number of them). Works managing seems to involve more effort and skill than power plant management because of the more diverse coordination problems involved both from the personnel and multiprocess standpoints.

Expense. In steam power plants the capital and fuel costs are the chief items of production expense, not labor. The principal cost control job has not been the management of men and work processes. From this it would seem the primary function of the plant superintendent is simply the direction of materials handling and efficient burning of fuel.

Upgrading plant super. In spite of the above reasons for explaining the present position of the plant superintendent, we feel there are other strong reasons to raise the management level of the plant superintendent's spot in the organization of the utility. An electric utility has two main functions: (1) produce electric energy (2) distribute electric energy to its customers. Executives in charge of these *prime* functions should occupy a prominent place on the management team, not a subordinate one.

The power plants of a utility are one of the most valuable assets of the company. Management of operation and maintenance of these costly facilities deserves high level attention in the company organization. High order technical skills must be used in running today's automated power plants. In turn, these need a high order of managerial skill which should command a high level on the management team of the company. Pure numbers of employees supervised are not an adequate test of the managerial skills needed for the job.

Maintenance of power plant equipment plays an important part in main-

1—Titles of executives in charge of power plants

Titles	*Number of companies*
Generating station manager	1
Station manager	1
Plant manager	1
Station general superintendent	1
Power plant superintendent	6
Generating station superintendent	2
Power station superintendent	1
Plant superintendent	5
Station superintendent	4
Chief engineer (station)	1

2—Immediate superiors of power plant executives

Titles	*Number of companies*
President and vice-president in charge of all company activities	1
Vice-president, production	1
Vice-president in charge of steam production	1
Vice-president, engineering and production	1
Director of operations and construction	1
Manager, power production	3
Manager, electric production	1
Production manager, electric department	1
Manager, production (department)	2
Manager, production and transmission	1
Manager, power generation	1
Manager, generation department	1
Manager of power supply	1
Plant manager	1
General superintendent, power plants	2
General superintendent of production	1
General superintendent, electric production dept	1
General superintendent of generation	1
General superintendent, steam generation	1
General superintendent, steam power division	1
Production superintendent	5
Superintendent of power production	1
Superintendent, power production stations	1
Production division superintendent	1
Electric production superintendent	1
Superintendent of generation	3
Superintendent, steam (hydro) generation	1
Superintendent, generating stations	1
Superintendent of power plants	1
Superintendent, power plant operation	1
Operating superintendent	2
Production engineer	3
Mechanical engineer	2
Operating engineer	2
Electric production supervisor	1
Supervisor, power plants	1
Generation supervisor	1

taining continuity of service; so does the operating skill needed. Management of these two important aspects of power plants should come from a high level in the organization.

Plant superintendents have an indirect influence on the design of power plants and the investment made through the advice they can give the designers on plant problems. This valuable experience can have important effects on capital investment. Executives with such influence should have high managerial authority.

Comparison. While the first set of reasons explain the relative lack of recognition given the power plant superintendent, they do not seem to be important enough to warrant continuing the present status. The costly and complex production function of an electric utility company is just as important to it as the factory operation of any industry is to the latter's business. In view of the high status given the works manager, it seems the utility can hardly afford to do less for the power plant superintendent. The utility needs to strengthen its management functions, not weaken them.

Superintendent's staff. The survey showed the staff organization reporting to the plant superintendent in six of the companies. This covered 18 power plants. Most of these included: (1) plant operation (2) electrical maintenance (3) mechanical maintenance (4) plant performance (5) office service groups. In four plants operation was split in two groups, one for boiler operation and the other with remaining operations. In five plants coal handling was a separate group from operations.

In five plants all maintenance activities were under one head who reported to the plant superintendent. Safety work is a separate staff function in five plants. Some plants have storekeeping, yard work, building maintenance and painting as separate groups.

Superintendent's superior. Usually the power plant superintendent reports to a general office executive with the rank of superintendent, general superintendent or manager. In only 3 of 52 companies do the supers report to vice-presidents; in only one company does the super report directly to the president. None of these four companies is a small one.

Table 2 lists the wide variety of titles held by the superintendent's executive officer. A few of them are titled *engineer, supervisor* or *director.* Only 13 of the companies showed that the superintendent's superiors have staffs to assist in managing the plants. Eight of these companies serve concentrated large city areas; five companies have wide-spread territories.

In 12 of these companies the staffs do production engineering (sometimes designated results, performance, betterment or efficiency engineering) tests, other laboratory work, maintenance engineering and supervision of mobile maintenance crews. In one company the staff consists of an assistant production executive.

In the large-city companies the production executive staffs tend to be somewhat larger and serve a wider variety of purposes than in the scattered-territory companies. Probably these staffs in large-city companies represent some consolidation of specialists that otherwise would be stationed in the individual plants.

Table 1 lists the variety of titles used to describe the executive in direct charge of power plant operation and maintenance. We have used the title *power plant superintendent.*

OPERATORS NOTEBOOK **130**

You can stop

Watch belt tension for longer belt life

RELAXED BELT has straight side, as shown by ruler. Rubber tries to bulge in pulley groove but sheave sides keep it straight

BULGED BELT is bent as when going around sheave. Bulge gives belt the added friction it needs to grip sheave, keep from slipping

Here's how you can diagnose belt failures

Oil deterioration

Oil saturation ruined the rubber in this belt. For complete protection against oil install splash guards. Where oil cannot be avoided replace your belts with ones that are resistant to oil

Cover fabric ruptured

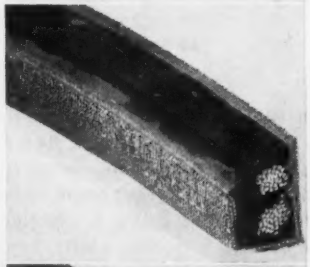
Cover fabric, left, was ruptured by prying belt over sheave during installation. Wood or metal falling into groove will do same thing. Avoid by moving motor up until belt fits into groove

Slip burn

Because this belt was too loose it didn't move; friction against sheave burned rubber. When belt finally did grab sheave, it snapped. So check tension. If OK, check drive for overloading

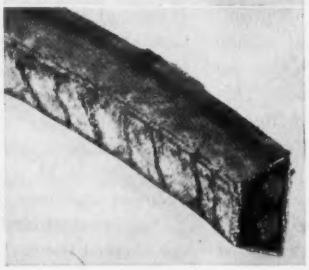
Snub break

Here's what happens when belt gets crack-the-whip action. Cover wear shows that belt was slipping badly, while clean break indicates a sudden snap. Keep belts taut — check tension



Abrasion wear

Sidewalls of this belt were worn away from foreign material and rust in the sheave until belt dropped to bottom of groove. Install dust guards. Belt must be kept taut in dusty places



Base cracking

This belt has been running against severe back-bend idlers, has been stored improperly or has been operating under high temperatures. Avoid ambients over 150 F and check storage

these V-belt headaches

STEVE ELONKA, Associate Editor

Follow these points for trouble-free operation

First rule for long belt life is to maintain right belt tension. Loose belts slip, causing belt and sheave wear. Snapping action of loose belt adds sudden stress, often breaks belt

To test for tension press down firmly on each belt as shown in the photo at left. If there is proper tension you can depress the belt an amount equal to the thickness of the belt for each four feet of center-on-center distance. This is an important fact to remember

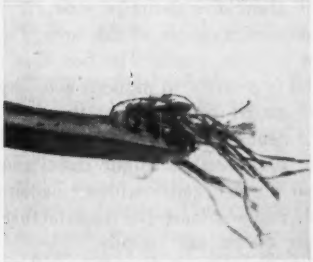
Keep sheave aligned or you'll have excessive belt and sheave wear. Unparallel shafts are common, cause belts to work harder on one side. In such a case belts wear faster and you have to replace entire set. Misalignment in sheave only is indicated by cover, sheave wear

Sheave grooves must be smooth. Dust, oil and other foreign matter cause pitting and rust. "Dished out" sidewalls ruin belts fast. A shiny pulley bottom shows that either sheave, belt or both are badly worn. Big headache with badly worn groove is that it causes belt to ride lower than others on the same sheave. Result: "differential driving," meaning that the belts riding high in the grooves are traveling faster than the low-riding belts. Here one belt on the sheave works against the other

More complete information on V-belt maintenance is given in a new 12-page booklet, "How to get longer life from V-belt drives," by B F Goodrich Industrial Products Co

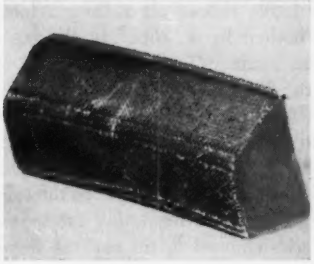
Ply separation

Too small sheave caused the split along pitch line on this belt. Remember: every belt size has a minimum sheave diameter. Always check the drive design and install right one



Rupture

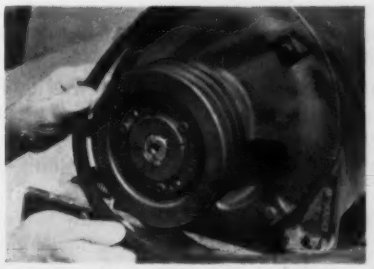
Many things can cause this condition. Rocks or tools falling into sheave grooves will rupture cords in the grommet or plies. Belts loose enough to twist in the groove can rupture cords



Worn belt sides

When the sides of your belt show wear, it may be from normal causes. But look for misalignment. Grit or dirt will also cause abnormal wear. Replace belt before the wear is excessive

Install belts right



MOVE DRIVER UNIT forward so V-belt can be slipped into the groove easily, as shown

DON'T FORCE BELT into sheave with screwdriver or wedge. Fabric, cords rupture

By W R SCHNARRENBERGER
Hagan Chemicals & Controls, Inc

1 Faulty tube resulted in this odd-looking bulge that spiraled outside of tube for a few feet like a vine on a tree trunk

Faulty tubes always appear as prime suspects when a boiler tube fails. Actually they are rarely to blame. This data will help you answer the common question . . .

Was failure caused by

It's true that faulty tubes are a cause of boiler-tube failure. And when investigating a sample of failed tube, the first question usually shot at us is: "Was it a faulty tube?" Well, the chances of it actually being a faulty tube are mighty slim.

During our many years of examining failed boiler tubes I'd guess that we've inspected nearly 5000 tubes. And of this number we've found only five of them to be faulty—a meager 0.1%. So since faulty tubes are such a rare occurrence let's make a close examination of the five different cases we've encountered.

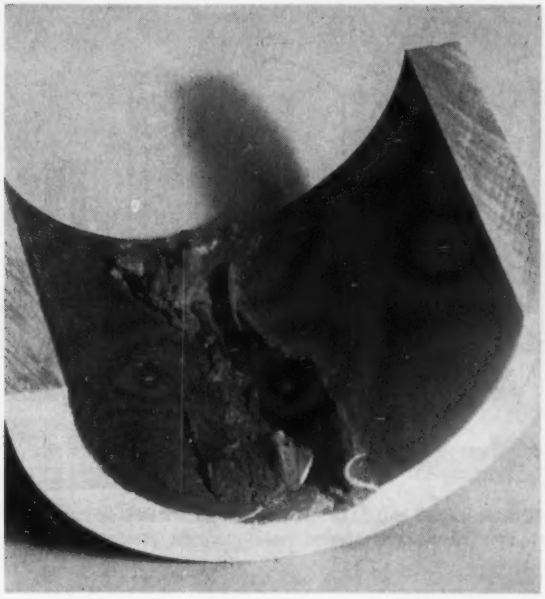
First of these is the weird failure shown in Fig. 1. Swollen ligament in this wall tube spiraled around the outside of the tube like a vine on a tree trunk. It extended only a few feet up the tube, but it must have been a strange sight inside the furnace.

Not to be outdone by the peculiar appearance of this failure, a second case came along looking like that shown in Fig. 2. Thin layer of steel on the inside surface of this tube had started to peel off like the red paint inside a rain gutter.

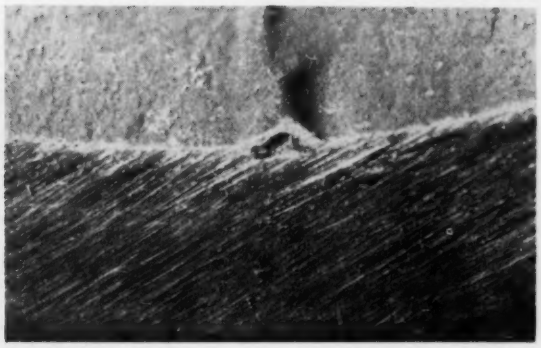
Third case, Fig. 3, is not nearly as impressive, but is closely related to the first two. Flaw in the wall of this tube was not as large, but nevertheless provides a starting point for many allied disorders. We have seen such a spot promote overheating, caustic gouging and hydrogen damage at grain boundaries of the tube. All three of the troubles, shown in Fig. 4, were brought on by just such a flaw in the tube wall.

Fifth case is a little different. The flaw is located about halfway between the inner and outer walls of a thick-walled steam header. Although photographs of the header section itself would not show this hairlike flaw, it is clearly pictured in the photomicrograph of this area, Fig. 5. You can see the flaw is quite small. The fact that it was brought to light at all is a credit to modern detection methods. This is borne out by the fact that the defect was found only after the header had seen over 20 years' service. This particular imperfection might have gone on undetected for several more decades without causing trouble. But its discovery made at least one manufacturer of an electronic detecting device very happy.

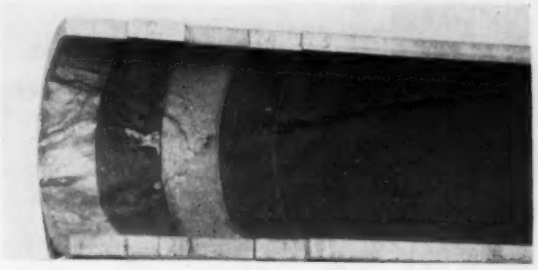
So here you have five faulty tubes—all of them related in one way. Each was faulted by a "pipe" in the ingot from which the tube was made. The cavity or mass of iron oxide or slag in the bottom was not trimmed off completely. Then, when rolling the ingot into a billet the "pipe" was transformed into a long thin stringer along the axis of the billet. As the billet was drawn out into a tube the piercing head forced the stringer to the tube wall. Result: the makings of any of the faulty tubes just described. In service, flaws showed up in various ways.



2 Another peculiar case of failure has the thin layer of steel on the inside surface peeling off the tube like a poor paint job



3 This tube flaw is not as extensive as Figures 1 and 2, but is closely related. It is starting point for many other troubles



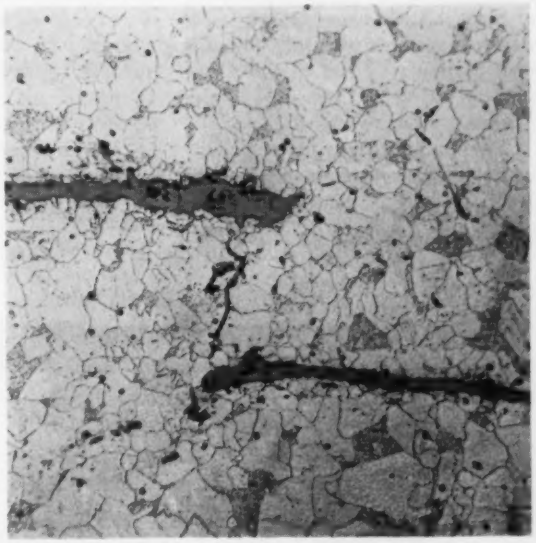
4 Damage promoted by flaw, *upper right*, includes gouging by concentrated boiler water, *upper left*, embrittlement and overheating. Cross section was taken at right of fourth tube slice

a faulty tube?

But in the case of the clinging vine, Fig. 1, what caused the artery in the tube wall to swell in service the way that it did? Our theory is that the pressure which caused the swelling came from a slow accumulation of gas produced by nascent hydrogen penetrating from the inside surface of the tube. Hydrogen formed continuously there by a slow reaction of the steel with the boiler water. This is also our explanation of the tube failure shown in Fig. 3.

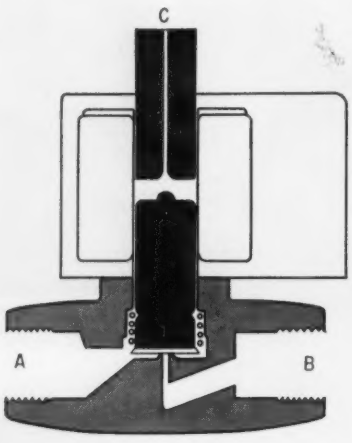
Peeling-paint case, Fig. 2, apparently opened to the inner surface either at the time of installation or, perhaps, soon thereafter. Oxide formed in the crevice and pried the overlaying layer of steel away from the wall. Figure 2 is a fine illustration of this. Damage in Fig. 4 is closely related. Perhaps peelings in this gouged area have corroded away completely and the ridge has not yet had time to start peeling again.

But, only a few faulty tubes out of the thousands upon thousands in service is truly a good record. And with new and better devices coming along for flaw detection this ratio will decrease even more. If you should encounter a failed tube and wish to diagnose the reason for its failure, we suggest you think long and hard before deciding to blame it on a faulty tube. The odds are about a thousand to one that something other than the boiler tube itself is really at fault, as our experience indicates.

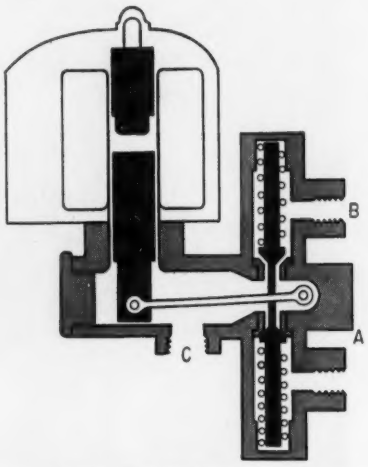


5 Photomicrograph of a flaw about half-way between inner and outer wall of a steam header showing the slag-like inclusion

By F E REEVES
Automatic Switch Co



MIDGET 3-WAY VALVE finds use for control of small cylinders, air diaphragms



LEVER-OPERATED VALVE serves as pilot valve, handles higher pressures and flows

Last part of our series on solenoid valve applications and operating tips shows . . .

How to use 3- or 4-way solenoid valves

In preceding portions (March and May 1959) we described direct-acting and pilot-operated 2-way solenoid valves. However, for fast positive movement of control cylinders in both directions or mixing and switching of chemicals, fluids or gases, 3- or 4-way valves enter the story. In this final portion we cover 3- and 4-way solenoid valves and sum up all valve types in a reference chart.

Three-way valves have two orifices and three pipe connections, are used primarily to control single-acting cylinders or larger diaphragm valves. Midget 3-way valves may be mounted in any position, and pressure may be connected to any of the three pipe connections. With solenoid de-energized, flow is between points *A* and *C* in either direction, and connection *B* is blocked. When energized, *A* is open to *B*, but *C* is blocked. To reverse the action, pressure connection can be switched from *B* to *C*. So pressure feeds when solenoid is de-energized, and bleeding takes place when energized. These are most common connections for 3-way valves.

Midget 3-way valves with small orifices control cylinders up to about 1-in. diameter and 12-in. long. They're also used with relatively small diaphragm motors. For larger cylinders or diaphragms, speed of operation probably would be too slow, and larger 3-way valves should be used.

Lever-operated valve has high mechanical advantage to permit use of larger ports and higher pressures. Disks are of needle-valve construction with metal to metal or metal to O-ring seats.

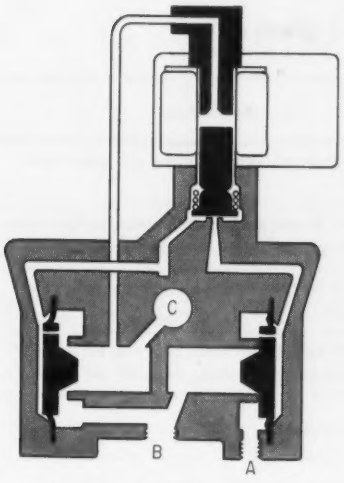
Four possible forms of flow appear in chart at left, second and third being similar to conditions described for midget 3-way valves. The first form with pressure at *A* would be used where one source of pressure or material feeds alternately into two different lines. The fourth form is used extensively in chemical treatment where two different gases or fluids feed to a common point on a metered or timed basis.

Unbalancing pressure valve essentially combines a normally-open and a normally-closed 2-way valve into one body controlled by a single solenoid. Two resilient diaphragms are used, and operation is similar to the operation of diaphragm valves described in Part One of this series.

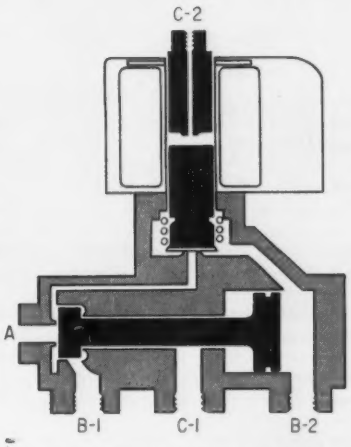
Valve uses midget 3-way pilot valve to control the operation of the two

Flow in 3-way solenoid valves

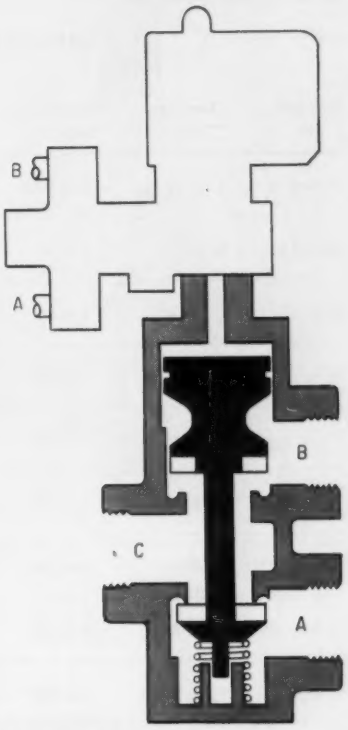
Solenoid	Pressure Applied At			
	A	B	C	B and C
Deenergized	A→C	A→C	A→C	A→C
Energized	A→B	A→C	A→B	A→C



UNBALANCING PRESSURE operates twin diaphragms combined to use one pilot valve



3-WAY INTERNAL-PISTON valve drives larger air cylinders or diaphragm motors



MIDGET 4-WAY VALVE supplies power in both directions for small air cylinders

diaphragms by an "unbalancing pressure" principle. Diaphragms are reinforced by brass inserts over the main orifice openings and at no time is line pressure impressed across flexing areas of diaphragms. A minimum pressure of 10 psi is required; maximum pressures of 250 psi are possible with this type of valve.

3-way internal-piston operated, 3-way pilot-controlled valve finds use for control of very large pneumatic cylinders or large diaphragm valves. Valves come in sizes from 1 to 2 in. and operate to 250 psi. They require a minimum of 10 to 20 psig to drive internal piston.

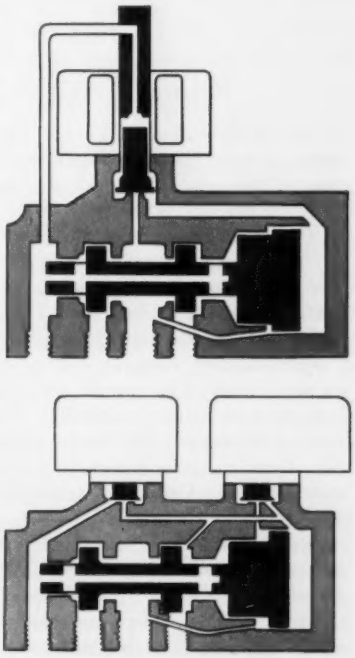
The 3-way pilot valve mounted on top of main body controls a piston which is driven in downward direction by air pressure, and returns by spring action. When piston is in up position, pressure bleeds from *C* to the exhaust connection *B*. The lower orifice is closed blocking off pressure from *A*. When piston moves to down position, upper orifice closes, blocking flow to exhaust connection. Lower orifice opens, allowing pressure to feed to *A*.

Pilot valve may be arranged to drive internal piston downward when solenoid is either energized or de-energized; the more common arrangement is to drive it downward under the energized condition. These valves find use for controlling large cylinders used to close high-voltage circuit breakers. For this service, very fast operation is necessary.

Four-way valve offers a more compact unit than two 3-way valves for controlling double-acting cylinders. Two general types are available—single and dual solenoid.

Midget 4-way valve of single solenoid type is shown above. This unit has five pipe connections because there are two exhaust openings in the valve for convenience in manufacture. This valve is again controlled by a 3-way midget pilot valve. Pressure connects to left-hand pipe connection and feeds through body cavities to lower resilient disk of 3-way midget pilot. In de-energized position shown, pressure is closed off by lower disk. However, pressure also forces against small end of valve piston and moves piston to its extreme right-hand position. Cavity at right-hand end of piston is open to exhaust around plunger of midget pilot and *C-2* connection. Right-hand cylinder connection *B-2* exhausts through same path. Pressure also feeds through main body to left-hand cylinder connection *B-1*.

When the coil is energized, upper orifice of midget pilot valve closes, its bottom orifice opens and pressure feeds to right-hand end of the piston. Since this end of piston is larger than the left-hand end, shaft and piston are forced to their left-hand position, per-



LARGE 4-WAY VALVES employ one or two solenoids. Dual pilot unit handles 1000 psi

Solenoid valve types and applications at a glance

Pipe size, in.	Port size, in.	Max pressure range, psig	Construction	Applications
⅛ and ¼	3/64 to ¼	0 to 5000	2-way, midget, packless, direct-acting, normally closed or open	Shutoff for air, water, light oil, and noncorrosive gases
⅜ and ½	5/16 and ⅜	0 to 40	2-way, packless, full pipe area, direct-acting, normally closed or open	Shutoff for air, gas, steam, propane, butane, water, gasoline, light fuel oil, vacuum
¾ to 2½	FPA*	0 to 10	2-way, packless, direct-acting, normally closed or open, mount vertical	Shutoff for low-pressure gas, air, light oil, water, vacuum
⅜ to 1	FPA	5 to 350	2-way, packless, internal pilot with resilient diaphragm, normally closed or open	Shutoff for air, gas, water, light oils, kerosene, gasoline, propane, butane, Freon 12, etc
1¼ to 3	FPA	5 to 250	2-way packless, internal pilot with piston, normally closed or open, mount vertical	Same as above
½ to 2½	FPA	0 to 100	2-way, packless, resilient diaphragm, normally closed or open, external pilot	Shutoff for semisolids, slurries, chemicals, etc
½ to 2½	FPA	0 to 150	Same as above, except cylinder operated with external pilot	Same as above
½ to 2	FPA	0 to 200	2-way, packed type, cylinder-operated with external pilot	Shutoff for corrosive gases and liquids
⅛ and ½	⅛ to ⅜	0 to 800	2-way packless, needle type, direct-acting, normally closed, mount vertical	Shutoff for corrosive gases, liquids and steam to 450 F
⅛ and ¼	3/64 to ⅛	0 to 300	3-way, packless, direct-acting, midget type	Pilot duty for air, water, light oils, noncorrosive gases and liquids
⅛ to ½	⅛ to ⅜	0 to 1000	3-way, packless, lever-operated, mount vertical	Pilot duty for control of cylinders or diaphragm valves
⅜ to ¾	⅝ and ¾	10 to 250	3-way, packless, dual diaphragm-operated	Control of cylinders or large diaphragm valves
1 and 2	FPA	10 to 250	3-way, packless, internal-piston operated, external pilot	Control of large cylinders
¼	1/16, 3/32	10 to 125	4-way, packless, midget	Control of small double-acting cylinders
⅜ to 1	FPA	10 to 1000	4-way, packless, poppet type, solenoid-pilot-controlled differential-piston operated	Control of large double-acting cylinders

*FPA—full pipe area

mitting pressure to feed to *B-2* and letting *B-1* exhaust through *C-1*.

Valve is very compact, but application is limited to control of 1 in. long by 1 in. diameter cylinders. For control of larger double-acting cylinders 4-way valves at bottom of p 191 may be used. Valve is available in either single- or dual-solenoid construction. In either case, main orifices are opened and closed by a differential piston. Line pressure always exists at small end of piston which is power operated in both directions by either feeding or bleeding at large end.

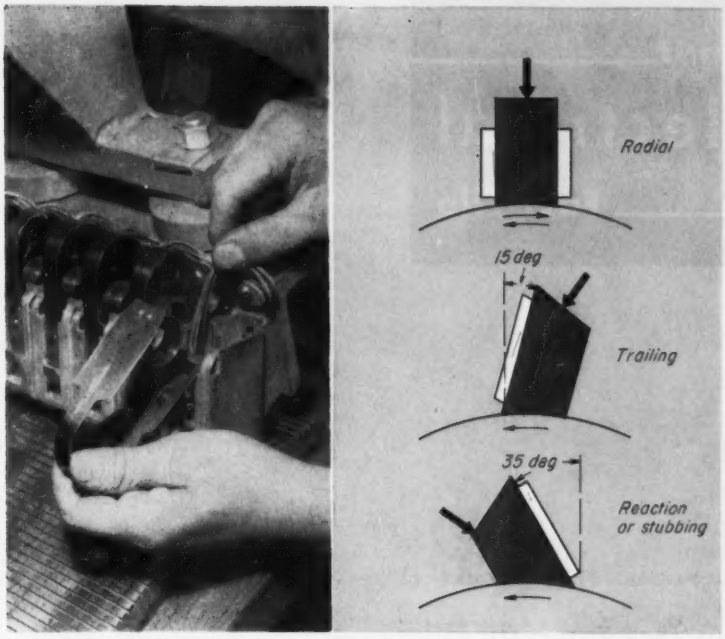
Single-solenoid design uses a 3-way midget pilot valve for control. With coil de-energized, pressure feeds from left-hand pipe connection through top orifice of the 3-way pilot to cavity in the right-hand end of valve body. The piston moves to the left to close pressure to *B-2* connection. *B-2* exhausts through connection and pressure feeds through hollow shaft to *B-1*. When the solenoid coil is energized, pressure is blocked at pilot valve top orifice and cavity at right end of piston bleeds to *C*. Unbalance in pressure drives piston to the right, opening the feed from pressure to *B-2* and exhausting *B-1*.

Dual-solenoid action is similar, except two 2-way midget pilot valves are used for control instead of one 3-way unit. Any leakage by piston rings empties into the exhaust cavity. Disks seat metal to metal with resilient seals.

Available in ⅜, ½, ¾ and 1 in., these valves handle pressures up to 250 psi in single-solenoid construction and 1000 psi with dual solenoids. All are full pipe area valves and may be operated at 850 cpm.

Table, above, sums up data on valve types. This plus text adds up to a basic reference on solenoids.

By G H GUNNOE Jr
General Electric Company



PRESSURE AND ANGLE of brush on commutator or slip rings must be correct for particular kind of service. Constant-pressure brush holder is designed to be self-adjusting

Brush holders: key to good commutation

For trouble-free performance of commutators and slip rings it is not only important to select the right brushes and maintain a proper rotating surface, but brush holders must be correct for the job and kept in proper adjustment.

There are three basic brush holders: *radial, trailing* and *reaction*. Radial brush is primarily for a reversing surface, but it's mechanically unstable and requires relatively high brush pressure to maintain contact. Many times, during reversal of machines, the brush develops a double fit and fails to maintain adequate contact, which is detrimental to performance.

Trailing brush holder is most popular type. This holder, in order to be stable, should make a 15- to 20-degree angle with the vertical, and have a bevel on top of the brush. The reaction brush holder should be operated between 35 and 40 degrees from the vertical, and also be beveled at top.

Each of the three types can be used on various types of machines when properly applied. For instance, the radial holder is primarily for reversing machines, but on larger machines the radial brush does not function too well because of mechanical instability and double fits. On heavy load applications requiring numerous brushes, loss of brush face and overlap prevents successful commutation. In such applications you can often use a holder which contains both leading and trailing brushes.

The trailing holder is used primarily for one direction of rotation. Reaction holder is used mainly on high-speed applications. It has the disadvantage of losing much of usable brush because of steep angle from the vertical.

Brush pressures of optimum values to minimize harmful arcing have been established by tests. It is essential to maintain uniform pressure on all brushes in the machine. Generally speaking, brush pressure that is too light is more harmful than that which is too heavy, for it will speed up not only brush wear but also commutator wear. It's not practical to specify a brush pressure that would cover all brushes; brush pressure must be set according to type of material and application requirements.

Electrographitic brushes should be operated between 3.5 and 4 psi. This value is increased for many special applications. Some slip-ring applications using low-density graphite carbons require pressure as low as 2 psi. Usually the instruction book provided with a new machine specifies correct brush pressure.

Brush pressure should be kept constant throughout the life of the brush. The usual type of brush holder doesn't maintain constant pressure, but must be adjusted as the brush wears. There are now available constant-pressure brush holders for both ac and dc machines which keep pressure uniform as well.

Maintain brush holders in good condition; set them at the spacings recommended at the factory. Keep hubs and pin mechanisms free and easy to operate. Always keep the reaction surface clean, and blow out the holder itself occasionally. Replace all springs subjected to current which have lost their temper. Make sure the brush holder finger is riding on the brush clip. These occasional checks will enable you to get the most out of your carbon-brush applications and help avoid trouble.

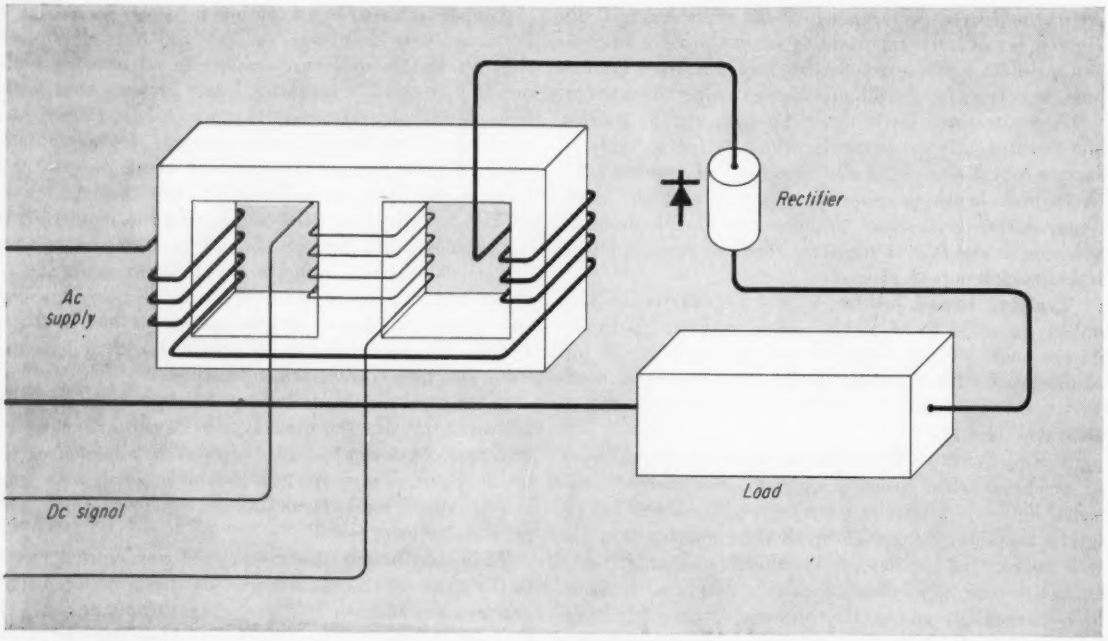
Plant Electrical Fact File

NO. 38: MAGNETIC AMPLIFIERS

We hear a lot these days about static control devices and how they are gradually taking the place of familiar contactors and relays. By *static* is meant having no moving parts: it doesn't refer to static electricity. The heart of a static controller is a magnetic amplifier. It may be simple or quite complicated, depending on what it's required to do. Magnetic amplifiers were developed from saturable reactors (see *Fact File No. 34*, March 1959). A dc control signal varies the degree of saturation in the magnetic core and thereby controls the impedance offered to the ac supply current. Weak signals can control large values of current, voltage and power in the load for industrial control applications.

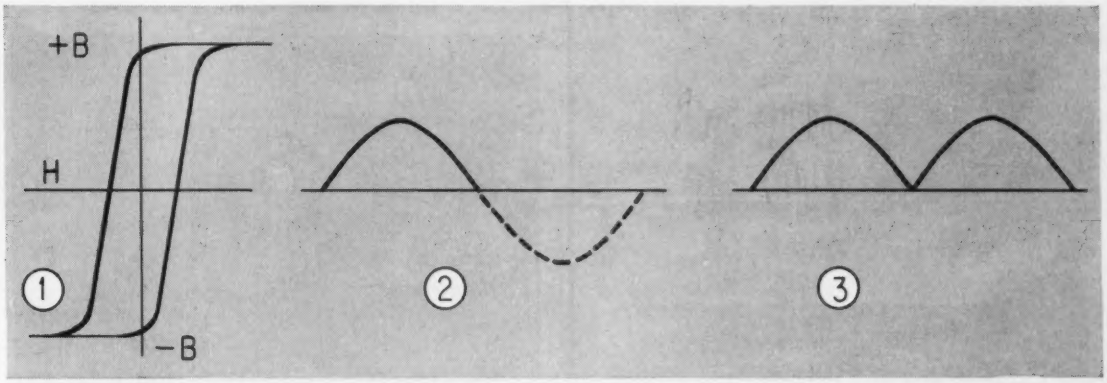
By NORMAN PEACH, Associate Editor

Two magnetic amplifiers for industrial control

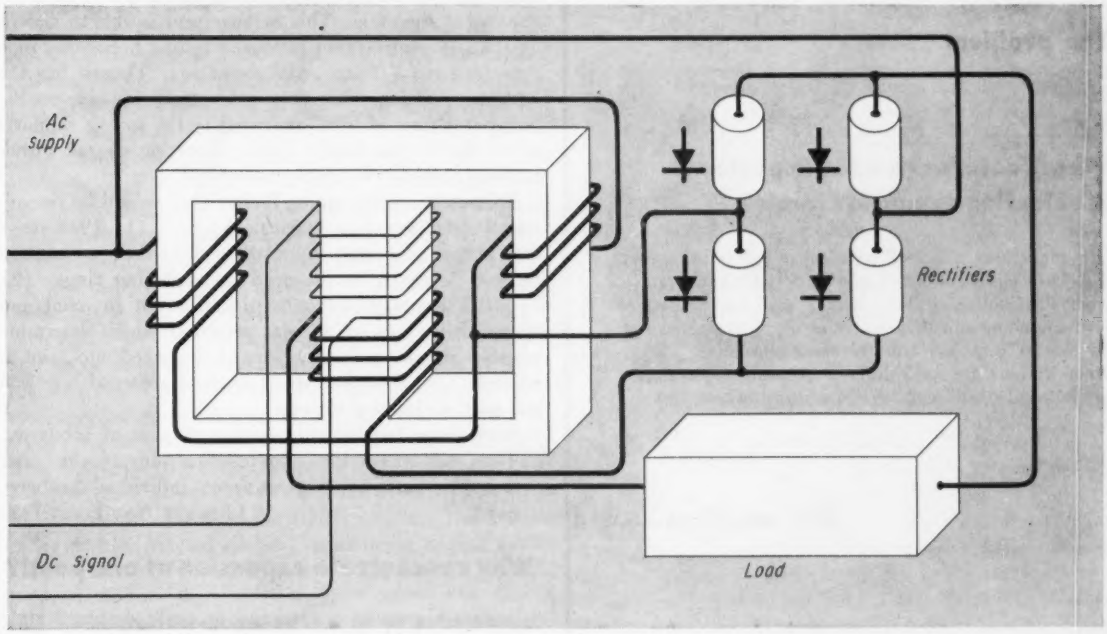


BASIC MAGNETIC AMPLIFIER has ac coils wound on outer legs so its flux won't link control winding. Dc control winding, however, sets up flux in entire core. A *self-saturating rectifier* is used in series with the load to produce a unidirection load current which assists the control winding in saturating the core. Less control power is therefore needed for a given control signal, and a much more efficient magnetic amplifier results. Better results are obtained if the ac coils are in parallel and each in series with a rectifier. Special magnetic materials are used.

Magnetic amplifier characteristics

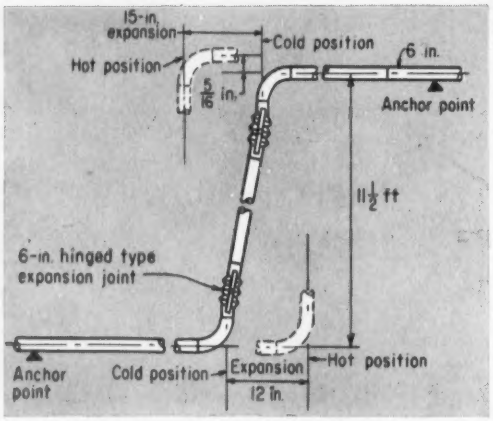


MAGNETIC CORE is made of material with a steep hysteresis curve (1). This means that a small variation in magnetizing force *H* produces a large change in flux density *B*, thus producing amplification. Simple magnetic amplifiers use one self-saturating rectifier. Output is half of an ac wave (2). More complicated feedback amplifier for dc loads has full-wave output (3). Curves shown may be distorted to some extent in actual magnetic ampilfiers.



FEEDBACK MAGNETIC AMPLIFIER for dc load can be used to regulate shunt field of variable-speed dc motor. Input signal is proportional to desired change of speed or amount of correction needed to keep speed constant. An additional (*feedback*) coil is wound on control leg of core. It's in series with the load through a rectifier combination. Changes in load current can be used to aid control signal (positive feedback) or reduce it (negative feedback). Positive feedback increases gain, negative feedback helps keep proportionality of output to input.

These **plant problems** could well be yours...



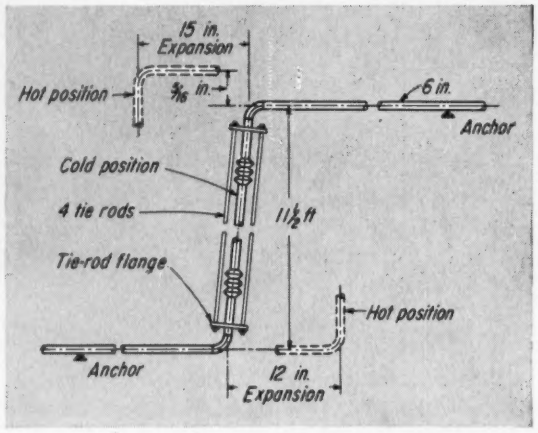
The problem

What factors are most important in selecting expansion joints?

Our plant uses a hinged type expansion joint, above. This is in service on a 275-psig 500-F total temperature steam-distribution system. Plans call for modernizing, expanding our facilities. Will it pay to standardize on this or any one type of expansion joint? What other designs are suitable? In choosing joints, what are factors to consider?—*DWA, April* POWER

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

The solutions



Universal joint is preferable solution

For *DWA's* problem, making assumptions for missing detailed data, the solution he presents is feasible. It's assumed that the 5/16-in. vertical expansion can be fully absorbed by the horizontal pipe runs between anchors. If this isn't the case, the expansion can be absorbed by another hinged joint in the horizontal.

Preferable solution, above, consists of a universal joint made up of two sets of corrugations and tied by rods from one end to the other. This arrangement is able to absorb all the lateral deflection produced by the horizontal pipe runs plus the 5/16-in. axial expansion. Thus it has the advantage of requiring only guide type supports on the horizontal runs of pipe compared to the spring supports called for by the hinged joint. Resulting overall installation is considerably more economical.

Following are the major factors that should be considered for bellows type expansion joints: (1) Pressure—determines adequacy of unstiffened bellows to contain internal pressure, or the need for stiffening rings. (2) Type of movement—expansion can result in axial and lateral deflections or angular rotations which determine whether simple, universal, hinged, balanced, etc joint is needed. (3) Temperature—influences material selection and need for internal sleeves.

Since these factors are varied and types of joints numerous, standardization is not practical. It's usually better to consider each application as an individual problem.

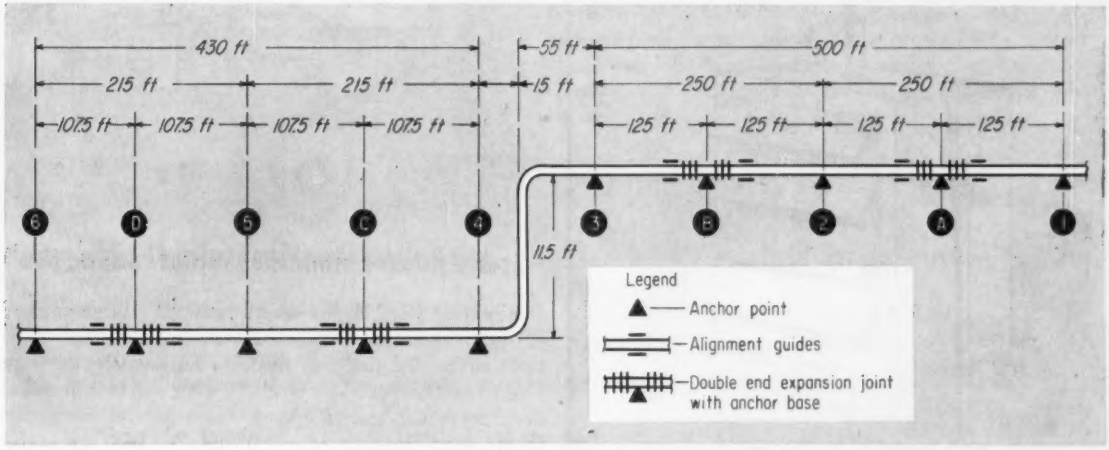
J FORBES, *New York, N. Y.*

Why concentrate expansion at one point?

Adequate alignment guides and properly designed rigid anchors are both highly important factors in expansion joint application. *DWA's* sketch shows a travel of 5/16 in. from cold to hot position of the 11½-ft pipe run. This is equivalent to 0.027-in. expansion per ft of pipe

...Here's how Power readers would tackle them

BOB MARKS, Associate Editor



or 2.7-in. per 100 ft. Total expansion in top pipe run is 15 in. So length of top pipe is 15 divided by 2.70 times 100, or 555 ft. Length of pipe in bottom run is 12 divided by 2.70 times 100, or 445 ft.

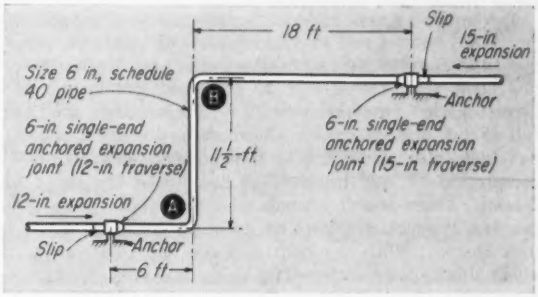
DWA should arrange his piping to take up expansion along the horizontal runs. Install expansion joints or pipe loops so all expansion is not concentrated at offset. My suggestion for an efficient arrangement is shown above.

Space the anchors on either side of 11.5-ft offset so offset can function as a Z-bend to absorb pipe movement between Anchors 3 and 4 without overstressing the pipe. The 500-ft run is divided into four equal segments of 125 ft each. Rigid anchors are placed at Points 1, 2 and 3. Place double-end expansion joints with center anchor base at *A* and *B*. Pipe on the other side of the offset can also be divided into four equal segments of 107.5 ft each. Rigid anchors are placed at Points 4, 5, and 6. Expansion joints are at *C* and *D*. They may be a bellows type for this service pressure and temperature with welding ends. Using four joints cuts the amount of traverse for each joint. On the 125-ft span it equals 125 divided by 100 times 2.70, or about 3⅜ in. Adding 25% to allow for contraction movement of the expansion joint gives a total traverse of about 4¼ in. for each 125-ft span.

Amount of movement for the 107.5-ft span, similarly figured, comes to 3⅝ in. Install a rigid pipe alignment guide as close as possible to weld end of expansion joint so it clears the weld when the piping expands. Use a three roller type guide or any other that allows horizontal travel without side or vertical movement. Support the pipeline between anchors at about 12 to 15 ft intervals.

Anchors must be designed to handle pipe stresses without distorting, moving or deflecting in any way. Cycling is very important in choosing an expansion joint. This refers to the number of times a day the temperature changes from maximum. Perhaps the plant or piping is shut down at night. Service may be continuous or intermittent at high temperature. Installation of bellows type joint must be done carefully to avoid overstressing or distorting. Follow manufacturer's instructions very carefully. *DWA's* job can also be handled by installing pipe-loops or expansion U-bends. When space permits these are usually preferred over expansion joints.

S R Higgens, *Long Beach, Calif.*



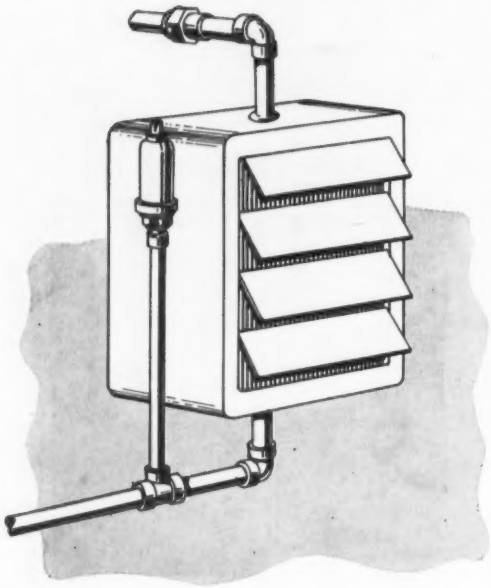
Try Z-bend and slip expansion joints

DWA's problem is not uncommon. Hinged-bellows expansion joints are very useful for this type of service. Performance is satisfactory if joints are top quality, properly selected and installed. If temperature fluctuations are infrequent, bellows are a good choice. Recommended alternate, above, uses slip joints for main span expansion and a Z-bend for offset flexibility. Locate anchor 6 ft from Elbow A and 18 ft from B. This Z-bend keeps anchor loads and pipe stresses within upper limits.

K S Roberts, *Philadelphia, Pa.*

Turn page for new problems ▶

More **plant problems**

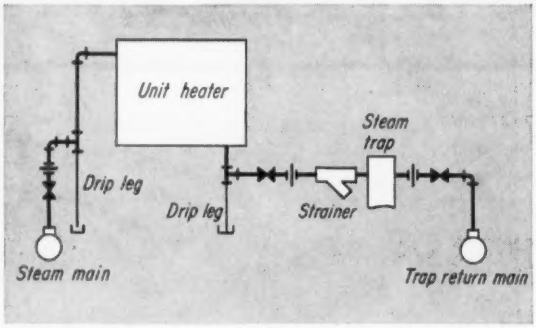


The problem

What's the best way to clean and maintain unit heaters?

Our plant has a great many horizontal and downflow unit heaters operating on low-pressure steam. Much of this equipment is well over 20 years old and to my knowledge has never been cleaned. The radiators are full of lint, dirt and grease. Needless to say efficiency has dropped considerably. We tried cleaning them with compressed air and brushes but this wasn't too successful. There wasn't enough time available during our last summer shutdown to do much work on the unit heaters. With the help available we were just about able to complete overhauling the rest of the heating system. Steam cleaning has been considered, but this isn't practical for the large office and cafeteria spaces. What is the best way to clean unit heaters and keep them operating at top efficiency? Any suggestions from readers will be greatly appreciated.—*RMM, April* POWER

The solutions



Spare heater simplifies maintenance job

One heating job I helped design included a large number of small buildings distributed over a wide area. Each building needed two unit heaters. Fortunately we were able to use one size and type of heater for each installation. Since the heaters operate for a part of every day in the year, there is no opportunity to take the entire system out of service for maintenance and cleaning. We solved this problem by purchasing a spare heater. Piping and all electrical connections on each unit are the same. Trap assembly on each is also the same and doesn't include a bypass.

This makes it very easy to replace heater or trap with spare equipment at some time during the day when it's not operating. Sketch, above, shows the hookup used. At regular intervals each heater and trap is taken out of service, replaced with spares, and taken to the maintenance shop for cleaning and repair. First all lint and loose dirt is blown out with compressed air. Next dirt and grease is removed by steam cleaning. When the heater is again in good operating condition it's stored until needed for replacement.

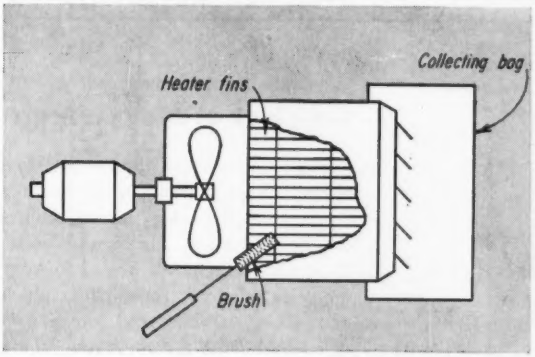
Later on some of the other steam piping in this plant was remodeled. We were able to use the same size and type of steam traps installed on the unit heaters. So these traps are now maintained the same way as those on the unit heaters.

H T LIVINGSTON, *Los Angeles, Calif.*

Consider use of a special cleaning tank

We know what a chore it is to clean up a large array of unit heaters. Neither blowing with compressed air nor wire brushing will remove all dirt and grime. If number of heaters warrants, build a tank large enough to submerge an entire unit. Locate it near a steam source and a sewer connection. Suspend a chain or electric hoist from the roof truss or a joist above the tank to lift heaters. Install a steam coil in the tank and prepare a hot caustic solution for degreasing. Lower each heater into the tank and agitate the solution. Second tank for rinsing is convenient, but flushing down with a hose is adequate. We cleaned 12 large heaters with one tankful.

T H ANDERSON, *Oak Ridge, Tenn.*



Regular heater inspection is called for

Unit heaters should be inspected at least every four months. Greater frequency is required if they are in a dirty atmosphere. For optimum efficiency check motors and bearing lubrication. Ball bearings are usually packed in enough grease for a year's operation. Sleeve-bearing motors are frequently furnished with wool-packed oil-lubricated bearings. Refill the oil cups after about 2000 hours' maximum operation. Avoid over lubrication with either type bearing to prevent damage to the rotor.

Clean the heating elements not less than once a year. Do it more often if atmosphere is dirty or corrosive. Brush fins at the air inlet side, as shown in sketch, above. Then place a bag over face of the unit and start the fan to collect loose dirt, lint, etc.

High-pressure air from the plant's compressed-air system will do a good job of cleaning out the elements from the air outlet side. For severe operating conditions remove the unit completely and spray with a mild alkali cleaning solution. Be sure to rinse thoroughly. A steam gun is very effective for both cleaning and rinsing.

Also clean the fan and casing periodically. Dirt may unbalance the fan and cause vibration, noise and bearing damage. Remove rusted and corroded spots and retouch with paint. They can be cleaned the same way as the heating elements. Blower type unit heaters are often furnished with air filters. Clogged filters greatly reduce heating capability. Periodic filter cleaning or replacement will keep this from being a problem.

H B WAYNE, *Woodhaven, N. Y.*

Remove heaters for a thorough overhaul

After twenty years without maintenance there is no easy way out. If you are going to do a job, do it all the way. These heaters don't owe you anything, but you can still get something out of them. Take the heaters to the shop and do a decent job. You'll have to do more than just clean the coils.

First disassemble heater and clean all the components. Acid clean the coils since they can be as foul inside as out. Clean the motors and fans. Don't try to straighten bent blades—it's easier and cheaper to replace the fan.

Replace any rubber vibration dampeners since 20-yr-old rubber is about as resilient as concrete. Check casings and mounts for cracks. Paint the casing with high-temperature enamel. Inspect all wiring and repair or replace. Check heater thermostats for point burning, excessive gap, sticking, etc. Clean strainers and repair or replace all traps. This is also a good time to correct any piping deficiencies at the heaters. Set up maintenance schedules and stick to them. Blow coils clean in the winter too, since it makes the summer job easier.

D R HETTELSATER, *Cheswick, Pa.*

Your July problems

Why are the tubes leaking in our 3-year-old boiler?

We have four horizontal-return tube boilers used for hot-water heating. Two boilers are only three years old; the others have been in service over nine years.

One of the 3-year-old units suddenly started to leak where the lower pass of tubes enters the rear tube sheet. Rolling them stopped the leak. But about two weeks later they started to leak again. Each time the upper pass remained leaktight.

This boiler has received excellent care. Boiler-water temperature ranges from 160 to 220 F, depending on outside temperature. Raw water was used for initial fill of the system. However, makeup is very slight and there hasn't been any excessive scale deposit, so we don't feel this is causing our trouble. The rear tube sheet somehow must have shifted to create the leak. To date we have not come up with a definite answer to our problem. I'm interested in hearing from any POWER reader who can explain our difficulty.—*DDC*

How can we increase the life of our salt storage tank?

Water treatment at our plant is handled by a pair of pressure filters followed by sodium-zeolite softeners. The equipment works well but the salt-storage tank gives us no end of trouble.

No matter what we do it always seems to look sloppy. Salt accumulates at the upper edges. Outer surface of the tank corrodes as this salt accumulation actually creeps over the top edge. Lower portion of the tank is also rusting away. Brine solution occasionally overflows and salt crystallizes on the bottom tank supports.

The tank is used until it practically falls apart, then we replace it. But I'm sure there is a better way to handle this problem. We'd like some ideas from POWER readers.—*BCR*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches

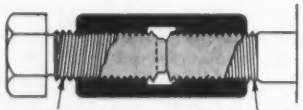
Timely **practical ideas** to help solve

Try this time saver when finishing welded surfaces

We welded the inside diameter of the throat ring on our 35,000-hp hydro turbine. When finished, we had to smooth the welded areas. On a welding job of this size some warpage may develop. But a true circle must be maintained since the clearance between the runner and throat ring is small. Usually such a job is done with portable electric- or air-driven grinders—a laborious chore.

The rig shown was made and installed by a mechanic in about two days. After striking centers in the turbine head cover and lower cone, ball bearings were placed in brackets. The vertical column of 4-in. pipe with adapters at each end was placed in these bearings. The horizontal arm was installed on this column so it could be raised and lowered. Two large air-driven grinders were installed at the end of the arm, one slightly higher than the other. These were held by cross feeds so two cuts of different depths were made with each swing of the arm. This contraption did a swell grinding job and saved us a lot of time.

L McWILLIAMS, *Shawinigan S, Que.*



Left-hand double thread, 3½ threads per in. *Right-hand, 8 threads per in.*

This stud puller works

Stud puller, sketch, saved my engine-room staff on board a motorship several hours of work. It also saved us a big dismantling job since we were able to renew the studs one for one with the engine running full speed. No time lost here!

Because the studs were loaded only a long socket wrench could be used to reach them. To make this tool, the left-hand thread on the cap screw had to be more than double the pitch of the right-hand thread. Our studs had eight threads to the inch, so we made the cap screw with 3½ threads.

H JOHANSEN, *Estevan, Saskatchewan*

Let's look at eddy currents

Just a few years ago, reports the Magnaflux Corp, eddy currents were a "disturbing influence" that electrical designers tried to eliminate. Today these same currents are used to learn many facts about rods, wires, tubes and other ferrous and nonferrous metal parts. See *Nondestructive Testing*, POWER, March 1958.

For example, today eddy-current devices indicate hardness, strength, alloy composition, chemical purity and heat-treatment conditions. They also detect cracks, porous or embrittled areas and locate welds and sudden changes in dimension. And they do all this at production speeds, on a 100% basis, if needed.

What are eddy currents? They are common or free electrons made to drift through metal under the influence of an induced electromagnetic field. They are an induced current, entirely within the part.

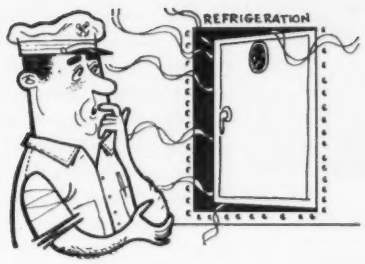
Minute eddy currents explore the part and can be utilized to give the kind of information mentioned above. With suitable controls tied into the eddy-current instrument, parts can be rejected, sorted or coded or the production process can be adjusted through a feedback-control loop.

Did you know that eddy currents have many of the properties of a compressible fluid? In some instruments their flow pattern and distribution are determined by (1) design of test coils which set up the radio-frequency waves and (2) frequency of oscillation of the waves. When currents encounter a discontinuity (crack, for instance) they detour around it and are compressed, delayed, weakened.

This causes a relatively large electrical reaction in the coil which can be simplified and reflected on a cathode-ray tube or by other means. Some instruments use a hand detector pick-up to determine electrical conductivity in absolute units and readout on a meter scale. Because many other properties are directly related to conductivity (hardness, alloy proportions, thermal conductivity, etc) such units have almost countless uses.

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor



What would you have done?

During the first World War, I was assigned as chief refrigeration engineer to the confiscated German ship *SS Derflinger*. Soon as she was converted to a troop ship we shoved off for Marseilles.

While in Marseilles, our captain heard that the English troop ship next to us had trouble. She was scheduled to sail after having been completely repaired. The troops were already assembled in the barracks near the dock. But at the last minute sailing was postponed.

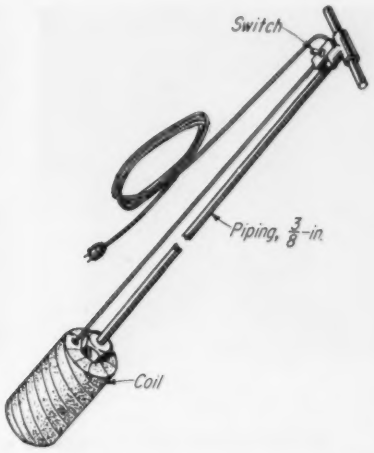
Trouble was her refrigeration plant wouldn't work. It was an ammonia system; the usual steam-driven compressor with the condenser housed in the body of the machine. The equipment had been thoroughly overhauled, condenser tested, new valves fitted where needed and everything put into first-class shape by the repair yard. But she wouldn't work.

After an expert arrived from England and could do nothing, my captain asked me to take a look-see. The troops had been waiting for a week. Ammonia smell was so strong that I could stay in the machine room only a few minutes. But I asked them to start the compressor. The headpressure built up immediately, although there was plenty of cool circulating water. I decided the system was blocked.

Ship carried Chinese coolies as firemen and sailors, so there was plenty of help. I had them open the oil separator, but it wasn't blocked. Then working while holding their breath, they removed the strainer cover. That, too, was OK. I'd dash in, hold my breath, make a quick check, then dash out. Discharge line between compressor and condenser had a new plug cock, with a shutoff valve on either side. Breaking the joint on one side of this manifold we got full headpressure, but on the other side nothing. I ordered the coolies to bring the manifold up on deck. After a lot of choking and coughing they accomplished their task.

The ship's personnel gathered around to see what was wrong. Shoving a pencil through the cock showed me the trouble. The new cock installed by the shop had been marked wrong. Instead of the mark running with the port it ran across the plug port. After changing the mark and reassembling everything, the unit was started, the troops embarked and the ship headed out to sea. What would *you* have done?

G McNALLY, *Kearny, N. J.*



You can make this handy picker-upper

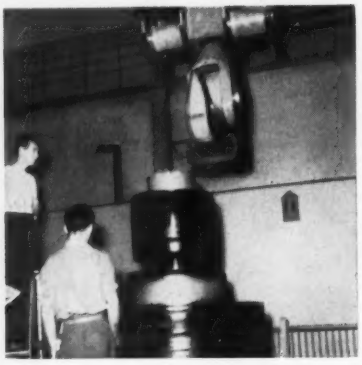
Maintenance men often drop tools, nuts, bolts and small equipment parts into tight places or machinery where they are hard to reach. Here's a handy picker-upper that you can use many times, sketch. Make the parts from scrap and spare parts. Use any old obsolete coil from a dc motor starting controller. Tape the coil on the outside, as shown, and varnish it. Make the pipe handle long enough to reach into all possible places in your plant and you're in business.

T MULLEN, *Seattle, Wash.*

Easy does it

We dropped a cleaning tool into a boiler tube while cleaning one of our large boilers. First we tried to fish it out with a magnet, but no luck. Then we called in a certified weldor and asked him to cut the tube so we could remove the tool. He took one look at the job, then asked for some large cellulose sponges. After soaking them in water he jammed them into the tube, one at a time. Then he inserted an air line into the tube end and jammed sponges in around it and held them in place. When the air was turned on, the tool came out fast.

J T BURKHARDT, *Homewood, Ill.*



Here's how we measure generator shaft runout

Shafts of large vertical generators in hydro plants often develop a swing or wobble — usually from misalignment or wear at the guide bearings. The wobble was cutting our efficiency, so we had to combat it.

We rigged up a dial indicator to measure our rotors. Closeup photo shows how the hook of our 200-ton crane anchors the indicator. It's solid enough to support the indicator and can be moved easily to any location.

We find this method makes it easy to measure the shaft's swing at the top end after rotating the generator. It's almost impossible on most units to install an indicator with the exciter stators in place. These views show only the top side of the unit at the armatures of the pilot and main exciters. Stators have been removed.

L McWILLIAMS, *Shawinigan S, Que.*

Check your hand extinguishers—now

During the summer drain water from hand (stirrup) extinguishers and check for serious rusting. Dry extinguishers found serviceable and coat on inside with a bituminous pitch that resists corrosive action of calcium-chloride solution. Then prepare for cold weather by safeguarding the buckets, pails, barrels and hand pumps needed for fire extinguishing in unheated plant areas. Be sure to clean and lubricate pump pistons and packing glands. See table below.

P C ZIEMKE, *Clinton, Tenn.*

Table for 2½ gallons of solution

Freezing temperature	Water, quarts	Calcium chloride	Specific gravity	Degrees, baume
10 F	9	5 lb	1.139	17.7
Zero	9	6¼ lb	1.175	21.61
10 – zero F	8	7 lb 6 oz	1.205	24.7
20 – zero F	8	8 lb 6 oz	1.228	26.9
30 – zero F	8	9 lb 2 oz	1.246	28.6
40 – zero F	8	10 lb	1.263	30.2

This table is based on granulated 75% calcium chloride

My biggest boner . . .

Arriving on the scene of an accident in our steam plant, I found some of the men bandaging one of the helpers. A call had been put in for a doctor. The fireman in charge was burnt slightly on the face and head.

I learned the fireman had inspected the hrt boiler check valve on the blowdown line while it was under 50-psi pressure. The valve had a square cover with four bolts holding it down. He had loosened three of the bolts. Then, as he slackened the last one, hot water splattered him on the face and head. Another man 10-ft away was badly burnt and later died.

I asked the fireman why he inspected the check valve while under such a high pressure. He told me it had been regular practice for years, and nothing had happened before.

"Well you won't be doing it any longer," I told him, "because you're fired as of right now!"

It still puzzles me why a check valve was placed on the blowdown line. I spent a few years as a traveling engineer, but I never ran into this hookup. I removed the check valve from the blowdown line so no one would pull that boner again.

J CURRAN, *Desbiens, Quebec*

Soak those gaskets

I had trouble with a hand-hole cover gasket leaking. Each time I drained the boiler and cleaned the hand-hole seat and cover I would install a new gasket. But after I filled the boiler and started up, the gasket leaked.

I tried different compounds on the hand-hole gasket but this didn't help. Then I took another new gasket, soaked it in very hot water for 15 minutes and ihstalled it. This time it didn't leak. My problem was solved.

AL KELLING, *Parma, Ohio*

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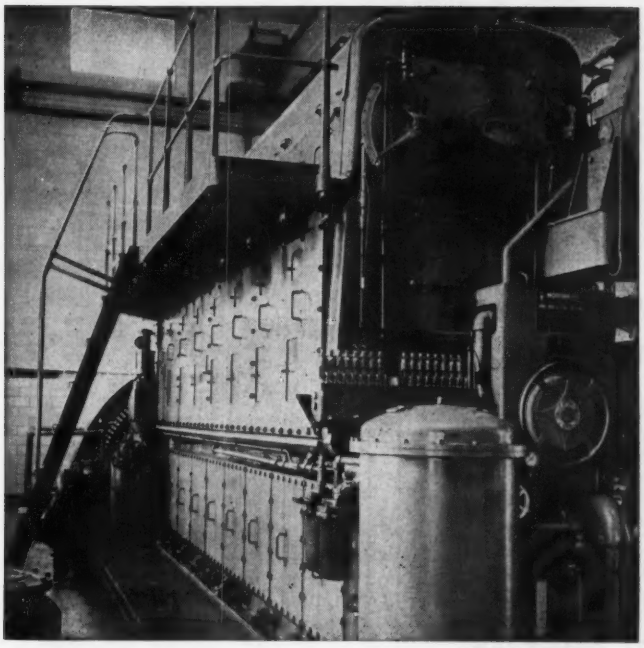

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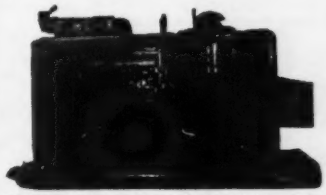

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750	G.E.	Slipring	2300	514
700	Whse.	Slipring	2300/4000	1200
600	G.E.	Synch.	450	900
600	Elliott (3)	Sq. Cage	2300	900
500	Whse.	Sq. Cage	2300/440	1200
500	Allis Ch.	Slipring	2300/440	600
500	GE.	Slipring	2300	900
400	Whse. (2)	Synch.	2300	1800
400	Whse.	Sq. Cage	2300	514
400	Marathon (2)	Sq. Cage	2300	3600
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch	2300/4000	400
350	Br. Boveri b.b.	Sq. Cage	4800/480	720
350	G.E.	Sq. Cage	2300	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2300/4000	600
350	G.E.	Slipring	230/440	900
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2300/440	1200
250	G.E.	Sq. Cage	2300/440	450
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Sq. Cage	2300	1800
250	G.E. T.EFC	Sq. Cage	440	1200
250	Whse.	Sq. Cage	2300/440	600
200	G.E.	Slipring	220/440	450
200	G.E.	Slipring	440	600
200	G.E.	Slipring	2300	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	2300/440	720
200	Whse.	Sq. Cage	2300/440	900
150	G.E. (4)	Slipring	2300/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. (2)	Sq. Cage	2300.440	1800
150	Whse.	Slipring	220/440	1200
150	G.E.	Sq. Cage	2300	900
125	El. Machy. (2)	Synch.	220/440	400
125	G.E. T.E.F.C.	Sq. Cage	2300	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. (2)	Sq. Cage	2300/440	720
75	G.E. b.b. (8)	Sq. Cage	220/440	1200

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Rel. TEFC b.b.	2550-F	230	850
150	Whse.	SK-210	230	230/1000
150	G.E. b.b. drn.	TLC-50	250	1750/3500
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
80	Whse. drn. b.b.	SK-123L	250	1800/5000
75	Whse. (4)	SK-163	220	500/1500
60	G.E. TEFC b.b.	CD-185	230	1150
50	G.E. drip b.b.	CD-1445	230	300/1200
50	G.E.	RF-16	230	250/1000
40	Whse. b.b. (3)	SK-143	230	300/1200
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
300	Gen. Elec.*	220/440 AC	125 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.	220/440 AC	250 DC
75	G.E. b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	G.E. b.b. (3)	220/440 AC	250 DC
40	Ideal	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Cr. Wh.	CCD	250	650
75	Gen. Elec.	CD-123	125/250	1200
75	Allis Ch. b.b.	ET-146L	125	1500
75	G.E. b.b.	CD-115	250	1500
60	Ideal	D	125	1150
60	Reliance b.b.	262-T	250	1200
40	Reliance b.b.	230-T	250	1200

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1250	*Al.-Ch.	ANX	3600
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600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-550-A	1800
300	*G.E.	K6544	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-500-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-549	3600
200	*G.E.	I-K-13B	1800
200	West.	CSP-581-S	1800
200	Brook	RS-27	1200
200	*West.	CS-950-A	900
200	G.E.	KT-564-S	720
200	*Al.-Ch.	AN-37-G	720
200	*West.	CS-1010	600
200	Al.-Ch.	ARW-631	600
150	Cr-Wh.	SC-140	3600
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5815	1200

M.G. SETS

Kilowatt	Make	Volts AC	Volts DC
1000	West.	4000	250
750	G.E.	4160	275
500	West.	440	250
400	Al. Ch.	2300	240
300	West.	2300	250
200	G.E.	2300	275
200	Ridgwy	2300	250
150	Al. Ch.	2300	275
150	West.	2300	250
125	Cr. Wh.	4160	125
125	G.E.	2300	250
100	G.E.	2300	250
100	Al. Ch.	2300	250
60	G.E.	220/440	250
40	G.E.	220/440	250

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H.P.	MAKE	TYPE	SPEED
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1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200
1000	*West.	CW	450
600	*G.E.	M-6845-S	1800
500	G.E.	M-6845	1200
400	*G.E.	MTP-585	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh.	SR-70-R	1800
250	Al.-Ch.	ARY-826	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	600
200	*West.	CW1950A	514
150	Cr-Wh.	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200

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1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT-6	6600	1137
1	800	Whse.	CW	550	1776
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	350
1	300	G.E.	MTP-561	2300	1800
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
1	250	Whse.	CW-1010	2200	435
1	200	Whse.	CW-874D	220	885
1	200	G.E.	IM	2200	580
1	200	G.E.	IM	2300	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

1	500	G.E.	FT-549AY	2300	3600
2	550	Whse.	CS-1118	2300	900
1	450	Whse.	CS-1216	2200	600
3	500	G.E.	KF	2300	3600
2	450	Elliott	3910BB	2300	1200
2	400	Whse.	CS	6600/4000	3565
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-905H	2300	1175/878
1	200	G.E.	KT-567	440	1800
2	200	Whse.	CS-8595	220/440	1750

SYNCHRONOUS

1	7000	G.E.	ATI	2140/6600	600
1	3500	G.E.	TS-64387	2300/4000	360
3	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	650	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1200	West.	720	600	2300/4160
1	1000	G.E.	900	250	6600
2	300	G.E.	1200	250	2300
1	500	G.E.	900	125/250	440
1	350	G.E.	900	125	440/4160
1	250	G.E.	900	250	220/440
1	240	West.	900	125	220/440
1	200	El. Mhy	1200	250	2300/4600
1	300	Whse.	1200	600	2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	300	G.E.	175/200# Cond. 480/2300 V.
1	1000	G.E.	150# no Cond 2400 V.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	PYR.	1	55/255
2	500	Kuhl.	OISC	1	13200x6600
6	333	G.E.	OISC	1	7200/12470Yx2400/4160Y

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300

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1—600 KW West. 3-60-4160V Auto-ext. 15#s

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1—400 KW Terry 3-60-440V Non-con, 15#s B.P.

2—250 KW Skinner engines 3-60-2300V

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PUMPS

10 MAIN FEED PUMPS

PUMP: Ingersoll-Rand — size 5" — three stage — capacity 500 GPM @ 750# discharge pressure. B.H.P 330 — 5000 RPM. *TURBINE:* Worthington-Moore — design pressure 575#/sq. inch — non-condensing — back pressure 20# — 5000 RPM — 330 B.H.P.

GEARED TURBINE-DRIVEN MAIN FEED BOOSTER PUMPS

PUMP: Mfg. by Buffalo Pump Co. — vertical single stage — capacity 550 GPM — 30# discharge — 8" suction — 5" discharge. *TURBINE:* 1 stage impulse — type Y-W — vertical — design steam pressure 575# — back pressure 20# — 12.5 HP — 5500/1750 RPM — mfg by Terry Steam Turbine Co.

2 MAIN FEED BOOSTER PUMPS

Same as geared turbine driven main feed booster pumps above, but with 14.5 HP 440/3/60 AC Star motor & Ward Leonard control. Across-the-line starter with pushbutton.

8 GEARED TURBINE-DRIVEN VERTICAL CONDENSATE PUMPS

PUMP: Main condensate 2-stage vertical pump — mfg by Buffalo Pump Co. *Capacity:* 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM — 22.5 BHP — 9" suction — 4" discharge. *TURBINE:* Single stage — 575# working pressure — 20#/sq. inch back pressure — 22.5 HP — 5360/1150 RPM — Mfg. by Terry Turbine Co.

2 AUX. FEED BOOSTER PUMPS

PUMP: Vertical — mfg by Buffalo Pump Co. — 200 GPM — 30# discharge pressure. *MOTOR:* 7.36 HP — 1800 RPM — 440/3/60 — Star motor, with control.

BRONZE RECIPROCATING STANDBY FEED PUMPS

11 x 8 x 18 — mfg by M. T. Davidson Co. — vertical simplex — capacity 180 GPM — 800/900# discharge pressure — 575# working pressure.

4 TURBINE-DRIVEN FIRE AND FLUSHING SERVICE PUMPS

PUMP: Worthington — horizontal centrifugal. *Fire Service:* 750 GPM capacity — 150 PSI discharge pressure — 3500 RPM. *TURBINE:* single impulse — type B-20 — mfg by B. F. Sturtevant — design steam pressure 575# per sq. inch non-condensing. Back pressure 15# — B.H.P. 80/90.

3 GEARED TURBINE-DRIVEN MAIN CIRCULATING PUMPS

PUMP: Mfg. by Worthington Pump & Machinery Co. — 28" type — vertical single stage — bronze. *Capacity:* 28,000 GPM — discharge pressure 13.5# — 600 RPM — 267 BHP — 28" suction — 28" discharge — 8.5:1 gear ratio. *TURBINE:* single impulse — vertical type — 575# design steam pressure non-condensing — back pressure 15#/sq. inch. RPM 5100 pinion — 600 gear. Reduction gear ratio 8.5:1 — 267 BHP — mfg by B. F. Sturtevant.

3 MOTOR DRIVEN MAIN CONDENSATE PUMPS

Mfg. by Buffalo Pump Co. — vertical 2-stage — 375 GPM — 70#/sq. inch discharge pressure — 1150 RPM. *Motor Data:* 25 HP — 440/3/60 — 1150 RPM — Star Electric Motor Co. — with across-the-line starter, with pushbutton station — mfg by Ward Leonard.

8 GEARED TURBINE-DRIVEN MAIN LUBE OIL PUMPS

Mfg. by Northern Pump Co. *PUMP:* Vertical rotary type — 750 GPM — 55#/sq. inch discharge pressure — 263 RPM — 35 BHP — oil viscosity 130 to 500 S.S.U. — 7" suction — 6" discharge. *TURBINE:* Single stage — 575# design pressure non-condensing — exhaust pressure 15# — 35 BHP — 26.39:1 gear ratio — 6940 RPM.

4 TURBINE-DRIVEN GEARED FUEL OIL BOOSTER PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 300 GPM — 150# discharge pressure — 282 RPM — 47.3 BHP — Oil viscosity 70-700 S.S.U. — 7" suction — 5" discharge. *DRIVE:* single stage impulse — 575# non-condensing — 15#/sq. inch discharge pressure.

6 FUEL OIL SERVICE PUMPS

Mfg. by Northern Pump Co. — vertical rotary — 85 GPM — 350# discharge pressure — 560 RPM — 27.4 BHP. *TURBINE:* 1 stage — 575# non-condensing — exhaust pressure 15# — mfg. by Northern.

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THESE ARE JUST A FEW OF THE MANY VALVES OFFERED. ALL TYPES ARE AVAILABLE INCLUDING REDUCING—SENTINEL—RELIEF—MICROMETER—PRESSURE REGULATING — ANGLE, ETC! STEEL—600# SERVICE—SEND US YOUR REQUIREMENTS FOR QUOTATIONS

LESLIE 2" GOVERNOR VALVES

Type C.P. — class A — capacity 7640#/hr. — 575# steam pressure — 750# discharge pressure.

MOTOR OPERATED GATE VALVES

Low Pressure — comp. geared — 38" — mfg by Chapman Valve Co. *MOTOR DATA:* H.P. 18 ft. lbs. running torque — 45 ft. lbs. max. starting torque — 440 volts 900 RPM 3 phase 60 cycle. Type: Submersible Valve Brake — Motor: Star Electric Co.
Also available, same as listed, but 36", and 28" inch as listed, but with smaller motor.

MISCELLANEOUS

AIR COMPRESSORS AND BLOWERS

18 WIDE RANGE FORCED DRAFT TURBINE-DRIVEN BLOWERS

9 R.H. — 9 L.H. — mfg by B. F. Sturtevant — propeller fan type — capacity 29,500 CFM/5540 RPM/250 BHP — 8250# steam/hr. — and, 9,000 CFM/1985 RPM/9 BHP — 690# steam/hr. — 7 blades — static: max 35" water — normal 21.5" water. Driven by Sturtevant turbine type VC-7 — non-condensing — single stage — 250 HP — 575# steam pressure — 15# PSIG exhaust pressure.

2 LOW PRESSURE AIR COMPRESSORS

Mfg. by Gardner-Denver — vertical tpye — 101 CFM @ 100# discharge pressure — 2 stages — 5¾ x 4¼ bore — 5" stroke — 870 RPM — 25 BHP. *MOTOR:* 28.6 HP — 900 RPM (sync) — 440/3/60 — mfg by Diehl — with Cutler-Hammer control.

1000 KW TURBO-GENERATORS

(4) — Westinghouse—440/3/60 — 850° — 540 lbs. working pressure. Complete with condensers, circulating pumps, etc.

LUBE OIL COOLERS

4 — mfg by Westinghouse. 1600 sq. ft. cooling surface — cylindrical straight-tube horizontal type. Oil capacity 590 GPM — water capacity 1500 GPM — temp. oil inlet 150°F — outlet 120°F — temp. water inlet — 85°F — outlet 90°F. Number of ⅝" tubes 816 — Wall 0.049 TK — Cupro-Nickel.

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7 B&W EXPRESS TYPE

Design pressure 634# — operating pressure 565# — temp. 850°F. Oil fired — separately fired superheaters. *Capacity:* 210,000 lb. steam/hr. Ideal for testing where large quantities of steam are required, giving excellent control from separately fired superheaters.

3 GLAND EXHAUST CONDENSERS

Foster-Wheeler — total capacity lbs./hr.: 1200 lbs. steam and 350 lbs. air — 155 sq. ft. — 4" ejector.

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1—500 KW G.E. Non Cond. 265 PSI, 0-10# BP

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400 HP West. Type CW 720 Slip Ring 440V
150 HP G.E. 900 TEFC 440V
150 HP West. Type CW 1800 Slip Ring 440V
75 HP West. Type CW 1800 Slip Ring 440V (2)
50 HP G.E. 1800/900 X.P. 440V TEFC (2)
50 HP Allis Chalmers 1800, 440V
40 HP G.E. 3600 D.P. Vert. Hollow Shaft (5)
30 HP G.E. 3600 D.P. Vert. Hollow Shaft (2)
30 HP West. Type CW 1200 Slip Ring 440V

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20000 GPM @ 60'—400 HP motor (2)
2600 GPM @ 173'—200 HP Vertical
1500 GPM @ 150'—125 HP Vertical
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1350 CFM Nash #7 VACUUM Pump

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77000	wye	5750	wye
44000	delta	4315	delta
38500	wye		
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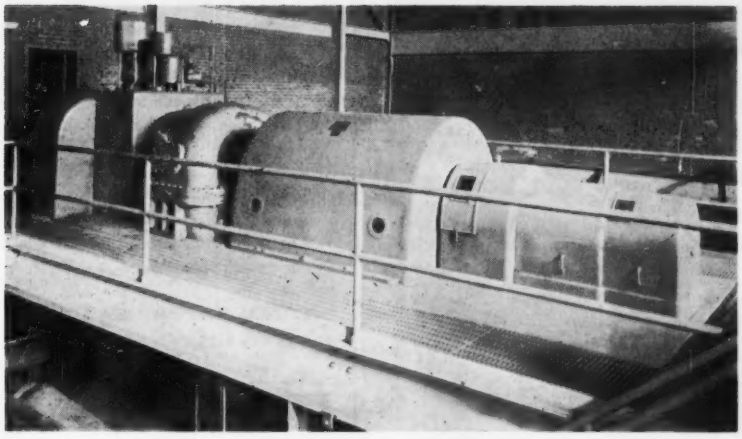

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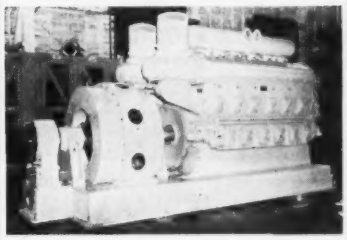

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400	West. S.B. Splash 2800 Volt	CS-99B	720
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300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
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250	G.E. S.B. Open	IK	1200
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250	G.E. S.B. Open	IK	720
200	Cent. T.E.F.C.B.B.	NP-686C	1800
200	West S.B. Open	CS	1200
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open 2200 v.	IK	1200
200	Al. Chal. B.B. Open		900
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125	Burke B.B. Open 440 Volt	N-505	3600
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	West TEFCBBCS	855	1200
125	Al. Chal. B.B. Open	AR	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	F.M. B.B. Open	H	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
125	West B.B. Open	CS874C	600
100	Howell T.E.F.C.B.B.	K-505	3600
100	G.E. B.B. Drip	K-504	3600
100	West. T.E.F.C. B.B.	CS-753	1800
100	G.E. S.B. Open	KT-343	1800
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STEAM DRIVEN COMPRESSORS

1138 CFM Disp Chgo. Pneu. 20" x 12" x 14" air cyl. 12" x 14" steam—1945. Can be conv. to elec. 767 CFM Disp. I-R. 2—17" x 10½" x 12" air cyls. 2—10" x 12" steam 1946.

HARRIS MACHINERY COMPANY
501 30th Avenue S.E., Mpls. 14, Minn.

FOR SALE—187.5 KVA 220 v. 3 ph. G.E. generator with 7.5 KW 125 v. exciter, connected to a 16" x 16" Skinner Horizontal Universal Unaflow steam engine. Operates on 150 PSI saturated steam. Exhausts at 5 PSI. Excellent running condition. Ideal as running or emergency standby for hospital. Must remove to provide for larger capacity unit. Reasonable offers accepted.

THE CALIFORNIA HOSPITAL
1414 South Hope St., Los Angeles 15, California

37 Years Dependable Service

SLIP RING MOTORS 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
400	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
300	440/220	G.E.	TS	450
300	2200/440	G.E.	TS	1200
200	2300/440	Whse.	G	1200
150	440/220	Whse.	G	1200
125	440/220	Whse.	HR	405

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
400	2300/4000	G.E.	K	1200
350	2300/4000	G.E.	SEDP	3600
350	2300/4000	G.E.	K	600
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis.	FS	1800
300	2300/440	G.E.	SEDP	1200
300	2300/4000	Cont'l.	Spl-Prf.	720
300	2300/400	G.E.	KT	600
250	2300/4000	G.E.	K	720
200	2200	G.E.	KT	1866
200	2200	Cont.	TEFC	3600
200	440/220	G.E.	KT	720
150	440	Whse.	X-pf.	3600
150	440/220	Cont'l.	X-pf.	1800
130	440/220	G.E.	TEFC	720
150	2200/440		KT	600
150	2300/440	G.E.	FT	1200
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200
100	2200	Cont'l.	TEFC	3600
60(2)	440	Cont'l.	X-pf.	1800

CIRCUIT BREAKERS, 3 Pole

4—1600 Amp., DA-50, Whse., 600 V., Air
1— 600 Amp., Al. Chal., 15 KV., Outdoor
6— 600 Amp., R. Smith, 7.5 KV., Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV., outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	600
50/60	230	Rel.	T	600/1800
50	230	G.E.(4)	CD	1150

MOTOR GENERATOR SETS

KW	Make	Input., AC	Motor Type	Output V., DC
300	Whse.	4150/460	Syn.	260/125
250	Whse.	440	Syn.	250
125	G.E.	440/230	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
70	El. Dyn.	440	Sq. Ca.	70
65	G. E. B	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch. 2400/4160Y—600 volts, 3 ph.
3—500 kva, G.E., 13800—2300 V.
3—500 kva, G.E., 13800—240/480 V.
3—500 kva, G.E., 2400—240/480 V.
3—333 kva, American, 2400—240/120 V.
1—300 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E., 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R, 220 V, 3 ph. con. LaRoi, 6 cyl.
only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

BOILERS

NEW UNASSEMBLED

# Steam/hr.	Key	PSI	Temp.
122,500	DF	565	850
121,650	DF	565	850
60,000	SF	435	750
74,000	H	280	500
55,000	A	240	—

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

Pelnik-Loconti Industrial Supply, Inc.
315 Oriskany St., Yorkville, N.Y.
Utica, N. Y. Ph. RE 6-4621, RE-2-4513

POWER HOUSE CRANES

Late Model *Excellent Condition*

- 150 Ton P & H Mfg. 1954
- 75/5 Ton Shaw Box Mfg. 1955
- 50/3 Ton Whiting Crane Mfg. 1955

ARNOLD HUGHES COMPANY
2765 Penobscot Bldg.
Detroit 26 WO 1-1894

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4800-120/240
3	167	G.E.	HS	1	2400/4160-240/480
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/3820Y/120/240
3	250	West.		1	2300/4600-230/460
3	500	West.	SL	1	2400/4160-240/120
3	50	G.E.	H	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
4	25	West.	Hyperail	1	2400/4160-120/240
3	75	G.E.	KF	1	2400/4160-120/240
3	25	G.E.	Dry	1	480/240-240/120
3	37½	G.E.	Dry	1	480/240-240/120
3	200	G.E.	HSW2F	1	2400/4160-240/480
3	200	Al.-Ch.	CB	1	60-2400/4160-240/480

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
1	75	EM	1200	250	Syn. 220V.
1	75	G.E.	1200	125	2300/4160 Syn.
1	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y SR
1	300	G.E.	1200	250	440 Syn.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Westghe 3/60/480—1200
1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	600	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
1	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2300
1	500	G.E.	1200	M369Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	92	West.	425/1000	175 FB
1	350	G.E.	1200	Pedestal
1	30	G.E.	1750	SK 113

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—275 HP, 1180 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1—100 HP, 1775 RPM G.E. KTP-543 3Ø 60-440V.
1—150 HP—1130 RPM, West. CS—2300V. Last B.B.
1— 50 HP 870 RPM West. CS 3Ø 60-2300 V.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

100 HP 900 RPM G.E. Form BL 2200 V.
125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 1800 RPM G.E. Type TS 220 V.
325 HP 900 RPM West—2300 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.

"FOR POWER"
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3227
PHONE NEW JERSEY—UNION 3-2600

FROM AIRCRAFT CARRIER "ENTERPRISE"

[4] 1000 KW GEARED TURBO-GENERATORS

For Condensing or Non-Condensing

1000 KW TURBO-GENERATOR COMPLETE WITH CONDENSERS CIRCULATING PUMPS CONDENSATE PUMPS AND SWITCH GEAR

GENERATOR: 1000 KW—type ATB-2—G.E.—form H.L.—1250 KVA—3/60/450—1605 amps—3600 RPM—0.8 P.F.—field amps 87—typical serial No. 5358205—with 120 volt 11KW DC exciter—compound wound.

STEAM TURBINE: 1000 KW G.E.—type FSN-4R-FN30-85TG—rated 7964 RPM—exhaust 1 lb. absolute when condensing.

REDUCTION GEAR: S-116—form A—RPM 7964/3000.

TURBINE STEAM PRESSURE: 375 lbs—175° F superheat-exhaust pressure 1 lb. absolute when condensing. Can be used condensing or non-condensing.

BUILT AS MARINE UNITS USING FINEST MATERIALS. DRIP - PROOF CONSTRUCTION. UNITS ARE 16' LONG — 7'8½" WIDE. MOUNTED ON PRE-FAB SUB-BASE.

OPERATING CONDITIONS

1. The turbines are designed for normal operation condensing at 375 lb per sq in gauge, 175° F superheat steam at throttle, and 1 lb. per sq. in. absolute at the turbine exhaust flange.
2. The turbines will operate successfully condensing at 375 lb. per sq. in gauge, 0° F superheat at throttle, and 1 lb. per sq. in. absolute back pressure at the turbine exhause flange.
3. The units have an overload capacity of 25% (1250 KW, 0.80 p-f) for two hours with normal main and exhaust pressures.
4. The units have an overload capacity of 50% (1500 KW, 0.80 p-f) for five minutes with normal main and exhaust pressures.
5. The units will deliver normal output (1000 KW, 0.80 p-f) with main pressure 20% below normal and with a back pressure of 2 lb. per sq. in. absolute at the turbine exhaust flange.
6. The turbines will operate sucessfully with a maximum main pressure at 450 lb. per sq. in. gauge and with a maximum superheat of 200° F at the throttle.
7. The turbines will develop 500 KW with 375 lb. per sq. in. gauge, 175° F superheat steam at throttle, and 29 lb. per sq. in. gauge back pressure at the turbine exhaust gauge.
8. The turbines will operate successfully when extracting steam from the second-stage shell of the turbine. An automatic pressure requisting valve and a non-return valve should be installed in the extraction line to hold the extraction steam at approximately 10 lb. gauge and to prevent a return flow of steam to the turbine.
9. The turbines will operate successfully with full steam flow to atmosphere.
10. The units will cover the entire range of conditions as listed above under automatic control of the speed governor.
11. The steam flow to the throttle is guaranteed not to exceed the amounts listed in Part V for the given loads when operating with steam at 375 lb per sq. in. gauge at throttle, 175° F superheat, and 1 lb. per sq. in. absolute at the turbine exhaust flange. The guaranteed steam flows include the necessary steam for sealing the packing glands, and includes the electrical losses for the exciter fields and rheostats.

THE BOSTON METALS CO.
313 E. Baltimore St. Baltimore 2, Md.
ELGIN 5-5050 LEXINGTON 9-1900

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Choice of the leaders: K&M high-pressure insulations

Where temperatures range up to 1350°F., you'll find leaders in all fields where heat control is important turning to "K&M" KaytherM. Because they can be *sure* with "K&M" KaytherM. There's no better insulation of its type. In low-pressure insulations, it does everything "85% Magnesia" does, and does it better. Composed of diatomaceous silica and quality asbestos fibers, "K&M" KaytherM is easily worked on the job, chemically stable, strong, and lightweight. Cement adheres readily.

"K&M" also manufactures a full line of Low-Pressure Insulations in pipe, sheet, and block forms, as well as in cements for all types of applications.

Whatever your insulation problems, you can rely on the eighty-five years of asbestos engineering that lies behind every "K&M" asbestos product.

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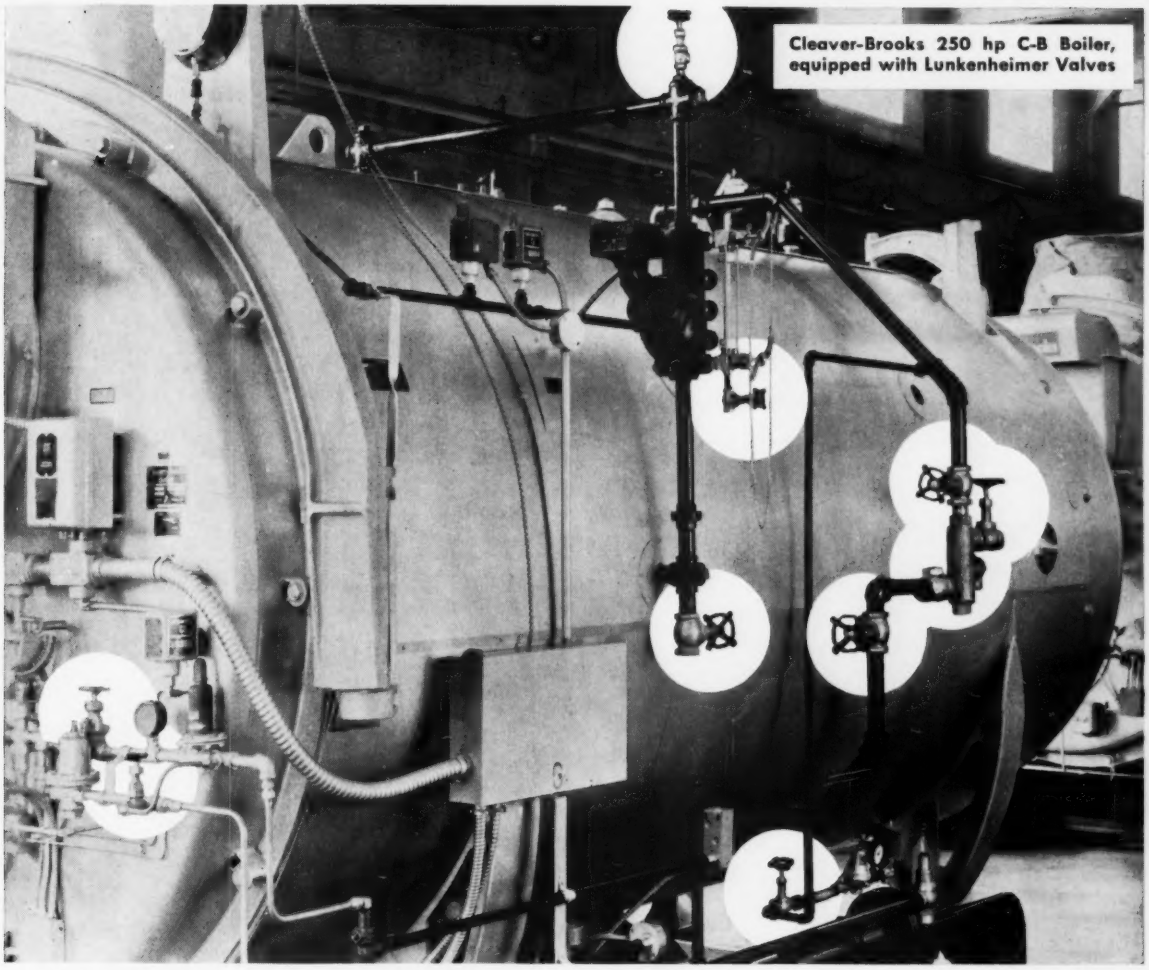
K·M
BEST IN ASBESTOS

For more facts circle 330 on Reader Service card, p 99



Cleaver-Brooks 250 hp C-B Boiler, equipped with Lunkenheimer Valves

TO KEEP MAINTENANCE COSTS LOW...

Cleaver-Brooks Boilers are Equipped with Maintenance-Saving Lunkenheimer Valves

Cleaver-Brooks, originator and world's largest producer of packaged boilers, stresses quality and performance. Thousands of users all over the world insist on Cleaver-Brooks Boilers because they know they can be sure of maintenance-free performance that pays for itself many times over in lower operating costs. Among the outstanding features of Cleaver-Brooks Boilers are Valves by Lunkenheimer—the longest-lasting, most maintenance-free bronze valves ever developed. Everywhere they are in service—as original equipment, on new projects, or in replacement service—Lunkenheimer Valves have established new standards for low-maintenance costs, unmatched by any other valves.

It always pays to specify the best . . . especially *when the best costs no more! For specific recommendations on maintenance-saving Lunkenheimer Valves, write The Lunkenheimer Company, Cincinnati 14, Ohio.*

LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

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where "specifications" usually fall short

If you plan to choose your next turbine generator by dollars and specifications alone, this message is not for you.

This message is intended for the engineer who looks beyond to the things that really count—the differences that affect turbine-generator performance and life.

We at Worthington believe there are four important such differences: specialization, craftsmanship, reliability and service.

"Specialization" refers to the manufacture of turbine generators in only the size range you are planning to install. At Worthington we specialize in industrial and municipal units. We don't claim to be experts in the larger central-station machines. On the other hand, we have developed a reputation as specialists for these units in our range.

"Craftsmanship" is attention to the details that make the difference in the machine's performance. At Wellsville, N. Y., Worthington turbines are built by men with long-standing records for loyalty and skill. One foreman has been with us for 33 years. One of our machinists recently retired after 40 years' service. Turbine generators have been built in Wellsville for over 50 years.

"Reliability" is the result of *many* things, including craftsmanship, that go into each machine. Reliability has become a creed for our engineering and production personnel. Every Worthington turbine generator is completely assembled and thoroughly tested as a unit before shipment, to best assure reliable and trouble-free operation.

"Service" includes many things besides trouble-shooting. It includes specially trained engineers and mechanics for every possible need, a minimum of "red-tape" in handling the business, speed and flexibility through personal contact, fast parts service, availability of data, training of operating personnel, etc. We believe service-to-you is just as important as the machine. This range of meticulous attention to service detail has resulted in an enviable performance record for Worthington turbine generators.

The next time you choose a turbine generator, remember that there are important differences you should consider. Look at specialization, craftsmanship, reliability and service. If you do, we're convinced you'll choose "Worthington." Worthington Corporation, Wellsville, New York. 48-6

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